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Canadian Holsteins

A seminar on quality

This publication gives the reader the equivalent of a seminar on Canadian Holsteins. Although intended for the informed breeder, rather than the technical expert, the authors have made every effort to ensure its technical accuracy and clarity.

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Canada's Dairy Industry

Canada, with a population of only 26 million people, is the second largest country in the world. It stretches 6440 km from the Atlantic to the Pacific Oceans and 4830 km from the United States to the Arctic Ocean. Most of its land is unsuited to agriculture because of forests, lakes, mountains, rocks or cold climate; we farm only 7%, most of which lies within 400 km of the southern border. However, this still amounts to 700 000 km^2 of farmland, which lets Canada rank among the world's foremost producers and exporters of food and livestock.

Dairy farming generates 17% of Canada's farm cash receipts, second only to wheat. There are about 1.4 million dairy cows, 95% of them purebred Holstein or with distinct Holstein markings and characteristics. Almost all dairy farms are family owned and managed, with little hired labor. The average herd contains about 38 cows, 15 yearlings and 20 female calves.

Variations across the country in climate, soil and size of markets create great differences within the industry in size of herds, concentrations of farms, value placed on dairying by provincial governments and individual breeders, types of cropping and feeding, ability of organizations to provide services over distances and size of the heifer industry.

Holsteins predominate in all regions despite the various conditions. They adapt readily to the lush pastures and moderate climate of the west coast, to the arid summers and cold (−35°C) winters of the prairies, to the warm (+35°C) humid summers of southern Ontario, and to the wide variety of feeds produced in the different parts of the country. Average milk yield per cow varies significantly, but superior management can give outstanding performance in all provinces.

Figure 1 Brabantia L Star Sandora (VG/TB) received a certificate of achievement for three consecutive lactations of 13 500 kg. Owned by Anthony Kilsdonk, she was bred by Arnold and Martin Byvelds. Her sire was A Investor Lonsfarm Star (Ex-Sp '85).
02-04 365 13905 566 4.1
03-06 365 14061 601 4.3
04-09 365 13785 662 4.8 448 3.2
ETA '87 CI: M +16 F +25 %
F +0.23

In most parts of Canada, cold winters force dairy cows indoors for up to 7 months, often into tie stalls. Injury to legs and udders can result, so breeders place great emphasis on high, firmly attached mammary systems and strong, properly shaped feet and legs. All dairy cows are milked by machine, which makes teat placement and shape important. Canadian farmers have abundant roughage to feed their cattle, and find that a cow with a large body and chest capacity is not only efficient, but also long-lived and healthy.

Politically, Canada is a federation of provinces. Since fluid milk cannot be shipped long distances economically, it is marketed provincially. Producer-controlled marketing boards buy and sell all milk, using a producer quota system. Only Quebec and Ontario produce milk powder, butter, cheese and other manufactured products on a large scale. Since these products move readily both nationally and internationally, they are regulated federally, based largely upon the policies of a national committee of provincial milk marketing board representatives.

The Canadian milk market is largely closed to imports, and only cheese, some milk powder, and a few other products are exported. Milk prices are based on the cost of production, in the absence of meaningful world prices with which to compare. Although all milk sold for manufacturing benefits by a moderate subsidy from the federal government, no government subsidies exist for export. All milk producers in Canada absorb any difference between the Canadian domestic powder prices and the world price received for exported powder, on a pro-rata basis.

In some provinces where the market is almost entirely for fluid milk, pricing emphasizes volume rather than composition. The different pricing structures across Canada determine in great part the breeding and feeding decisions by dairy farmers. So although Canada does not have a large number of dairy cows, it does have a remarkably wide variety of characteristics within the Holstein population suited to the different conditions across the country.

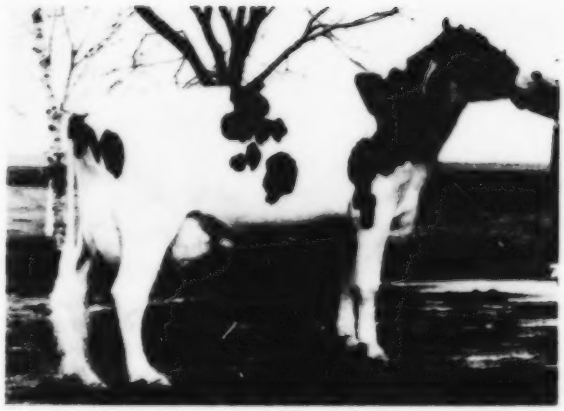


Figure 2 A total performance champion, Granduc Neptune Sheik (VG/TB), has the highest total BCA in her age class. Owned and bred by Ferme Leduc and Frères, Ltee., she was sired by a Pudget Sound Sheik (VG/TB Extra '80).
05-05 305 15942 675 4.2 518 3.2
BCAs: M 307 F 348 P 318 T 973
ETA '86 CI: M +11 F +19 %
F +0.22.

Figure 3 Canada's farming areas

Farming Areas

Forest

Tundra

Figure 4 Distribution of milk cows in Canada, by province

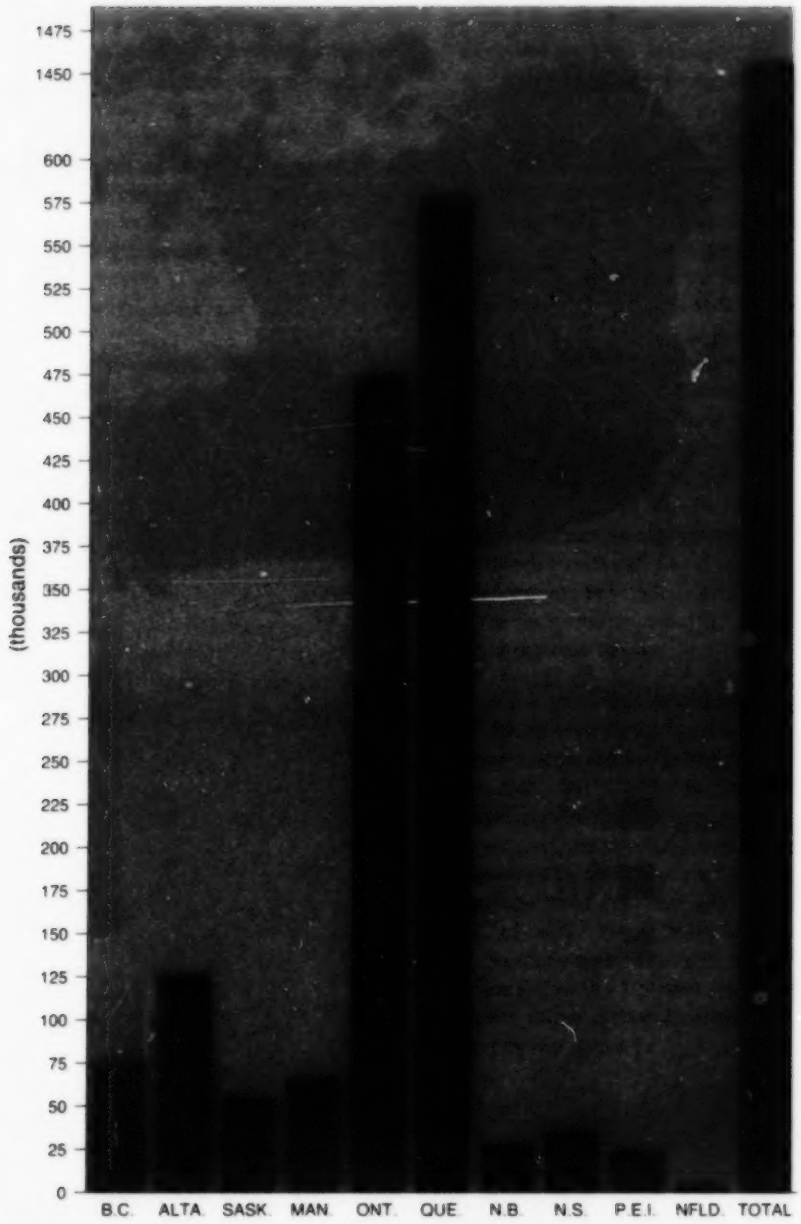
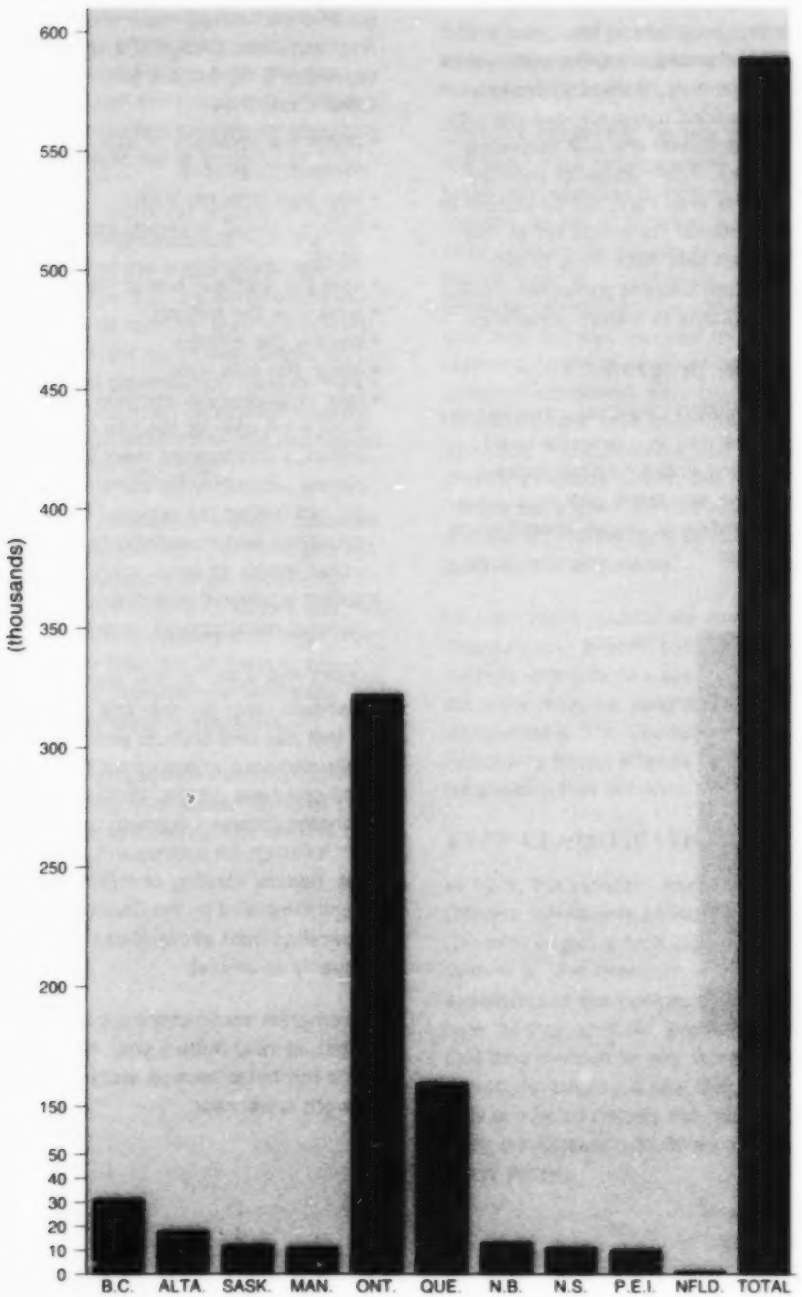


Figure 5 Registrations of purebred Holsteins in Canada, by province



Data Collection

MILK RECORDING

Performance testing has been available in Canada since the early years of this century. Currently, producer organizations (generally one per province) administer the milk recording programs. The number of services they offer may vary, but all adhere to strict national standards set by the Canadian Milk Recording Board. Agriculture Canada personnel monitor the programs to ensure adherence.

Official programs

SUPERVISED OFFICIAL Herdowners who take part in a program must enroll their entire herds of milking age cows and every cow must have a registration or unique identification certificate.

Figure 6 A supervisor checking milk-recording data

Supervisors (employees of the producer organization) make unannounced visits at slightly irregular intervals 10–12 times a year. During these visits, they:

- check the accuracy of milk-measuring devices;
- take bulk tank readings;
- record calving, breeding and dry dates;
- note the animals' health status;
- supervise the milking;
- identify the animals;
- weigh the milk yield;
- take proportionate samples of milk from each cow for the two daily milkings and forward them to a central laboratory for butterfat and protein testing (an optional cell-count test also is available to monitor udder health on each cow); and
- collect additional information for optional management reports.

AM-PM (OR A/P) In this plan, the supervisor visits for only one milking per test day and collects yield data, a milk sample for component testing, dates and herd details. Visits are alternated between morning and afternoon milkings on subsequent test days. Special scrutiny of milking times recently imposed by the Canadian Milk Recording Board allows these records to qualify as official.

The program administrators rotate staff so that, at least twice a year, breeders of the top herds receive visits from a different supervisor.

Herdowners must submit to 48-hour recertification testing on herds in which any animals appear to be recording extremely high (the top 0.5% of Holsteins) and discontinue any practice that creates an abnormal yield of milk, fat or protein.

The milk recording organization processes the information from the lab results and the supervisors' reports, and returns it to the herdowners in the form of monthly herd summaries, management recommendations and individual performance records (which include projected production figures). It also provides lifetime milk production records for each cow.

A cow's production is also expressed as a deviation from the herd average (see explanation in the section on genetic evaluation). Breeders use this information to identify their high producers of milk, fat or protein, select calves for replacement and make individual feeding decisions.

Herdowners pay fees that cover 35–70% of the programs' costs. Optional services are covered almost entirely by user fees.

Other testing programs

Some provincial producer organizations offer testing programs that are not considered official.

OWNER SAMPLER In this program, the herdowner notes weights and takes milk samples in bottles left monthly by the supervisor. A supervisor collects the figures and sends the samples to a central lab. The resulting records are for within-herd use only, but can be used by Agriculture Canada in sire proving if stringent conditions have been met — the animals have been uniquely identified, the supervisor has verified this identification yearly, the milk meters have been verified annually and test-day yields have been checked against milk shipments.

Unsupervised records are useful for statistics and genetic evaluation but records with different standards of accuracy must be weighted to allow comparisons. The Canadian Milk Recording Board intends to introduce regulations that enhance accuracy.

TYPE CLASSIFICATION

In 1925, the Holstein Association of Canada (commonly called Holstein Canada) began a type classification system to give breeders an unbiased evaluation of the conformation, or type, of their animals. Breeders found that they needed to pay more attention to developing a cow that not only produced heavily but had the body conformation to do so over many years.

Type classification is a major tool in breed improvement. Holstein Canada has improved the program over the years; for example, in 1982 it introduced the advanced linear method of evaluation and revised the statistical method for calculating sire proofs. Canada became, at that time, the first country to have a completely linear system. In 1989, the association became the world's first organization to implement the BLUP-Animal Model genetic evaluation technique for both cows and bulls.

Standards and regulations

Holstein Canada administers the type classification program. Classifiers travel extensively, each evaluating 9000 to 10 000 animals a year. The association selects these specialists for their knowledge of dairy cattle and their ability to evaluate animals according to strict standards. Individual classifier performance is evaluated throughout the year to maintain a high degree of uniformity.

Type evaluations are expressed as a comparison to a "true type" animal, an ideal that can never be attained. The Holstein Cow Scorecard places a relative emphasis on an animal's parts: general appearance 20%, dairy character 14%, capacity 14%, feet and legs 12%, rump 10% and mammary system 30%. A committee of knowledgeable breeders, which advises Holstein Canada's Breed Improvement Committee on program policy, meets with the classifiers semiannually. At these meetings, they review the program and the breed and introduce subtle changes.

Classifiers make their initial evaluations during a cow's first lactation. All unclassified females that have calved at least once must be classified in a herd. This rule eliminates selection bias in sire proofs. Subsequent evaluations reflect the animal's development as it matures.

To maintain a high standard of excellence, the percentage of animals classified into each final class is kept more or less constant. Half of the females are evaluated in the top three final classes, the other half in the lower three.

The percentages reflect further regulations. Once classified, an animal may only be raised in classification, not lowered. A cow does not receive high scores until she has calved a number of times and has had the opportunity to produce large quantities of milk (to be eligible for Excellent, a female must have calved at least three times; a male must be at least 36 months old).

Fees

Breeders had significant input into the design of the information collection method. They find the Canadian program so valuable for their own breeding program that they support its entire cost. They pay a fee for each visit to the herd and for each animal classified.

Artificial insemination (AI) units encourage the use of unproven young sires by paying the fees to classify their first daughters.

Table 1 Percentage of Animals Classified in Each Class

CLASS	SCORE	FEMALES		MALES
Excellent	—	0.2	0.2	6.46
Very good	88 & 89	0.2		
	87	0.5		
	86	2.0	5.7	26.98
	85	3.0		
Good plus	84	0.6		
	83	3.0		
	82	9.0	45.5	51.37
	81	14.0		
	80	19.0		
Good	79	2.0		
	78	15.0		
	77	15.0	45.0	14.52
	76	8.0		
	75	5.0		
Fair	70-74	3.0	3.5	0.65
	65-69	0.5		
Poor	64 & less	0.1	0.1	0.02

Source: Holstein Canada

Classification procedure

Once every 9 months, Holstein Canada invites all its members to apply for classification. These intervals are called "rounds of classification".

Classifiers use a linear system of evaluation. They describe each animal trait on a scale of 1 to 9, in which 1 and 9 are the biological extremes (small and large, narrow chest and wide chest, etc.).

The classifier's report for each female describes in detail the most important body parts and defects and provides a scorecard breakdown in eight categories. You may follow the procedure on the sample report (Figure 8):

- From the breeder, the classifier obtains the animal's last calving date, lactation number and information as to whether or not she has previously been classified.

Figure 7 A classifier scoring cows

- After a general inspection of the animal, the classifier describes her in terms of *four general characteristics* — size, stature, style and angularity — for which a score of '9' represents the ideal.

  Stature is her height at the withers. A mature cow that receives a '9' must be 149 cm or more. At the other extreme, one less than 130 cm would receive a '1'.

  Size describes the animal's weight. A cow 24 months old that weighs less than 408 kg receives '1'; one weighing more than 590 kg receives a '9'.

- The *14 descriptive areas* are considered next, starting with the front and working down through the midsection, rump, feet and legs and the mammary system.

  For 12 of these parts, '9' represents the ideal. The traits evaluated in this manner are head, chest width, loin strength, thurl width, depth of rear heel, bone quality, udder texture, fore udder attachment, rear udder attachment, median suspensory ligament, front teat placement and rear teat placement.

  For the other two parts (pin setting and set of rear legs), neither extreme is desired. They are scored to the midpoint '5'; that is, animals with extremely straight legs are '1' and those with extremely sickled legs are '9', while animals with low pin settings are '9' and ones with very high pin settings are '1'.

- The classifier notes up to 60 possible defects as slight or pronounced by writing one or two ticks, respectively, next to the defect on the report card.

- Using the information recorded so far, the classifier evaluates the cow in the *eight scorecard breakdown categories* at the bottom of the report. These are general appearance, dairy character, capacity, rump, feet and legs, mammary system, fore udder and rear udder.

  This part of the evaluation compares each of the main body sections of the animal against the true-type model. The classifier uses the categories Excellent, Very Good, Good Plus, Good, Fair and Poor with further subcategories 1 (low), 2 (medium) and 3 (high). For example, dairy character might be ranked VG 1.

- Good 3, Good Plus 1 and Good Plus 2 are the most used designations for most body parts.

- The final class is then assigned and the final numerical score entered, e.g., VG 87. These two evaluations are based on the scorecard breakdown, with more emphasis placed on the mammary system and feet and legs than on the other categories. If a cow is evaluated as excellent, no final score is assigned.

- Finally, the classifier checks each cow against her registration certificate and records the registration numbers of her sire and dam on the classification report. The classifier does *not* see the registration certificate before classification.

- Both the breeder and the association head office keep copies of the report. The office uses the report as the basis for sire proofs, herd breeding advice and a variety of other services. The breeder uses it as well as advice taken from artificial insemination studs to determine strengths and weaknesses of each animal and then select service sires.

A similar format is used to classify bulls.

Holstein Canada has introduced handheld electronic data-entry devices that print a similar report for the breeder right at the farm, then store the information for nightly transmission to the head-office computer.

OTHER TRAITS

MILKING SPEED In some milk recording programs, the herdowner records milking speed and reports the evaluations to the milk recording organization. The University of Guelph, in cooperation with Agriculture Canada, has calculated national milking speed proofs based on these subjective evaluations.

CALVING EASE Data on calving ease is collected by some, but not all, milk recording agencies across the country. A breeder subjectively rates and records the observed ease of calving on an agency's written scale. The agencies publish regional sire proofs but national figures are not available.

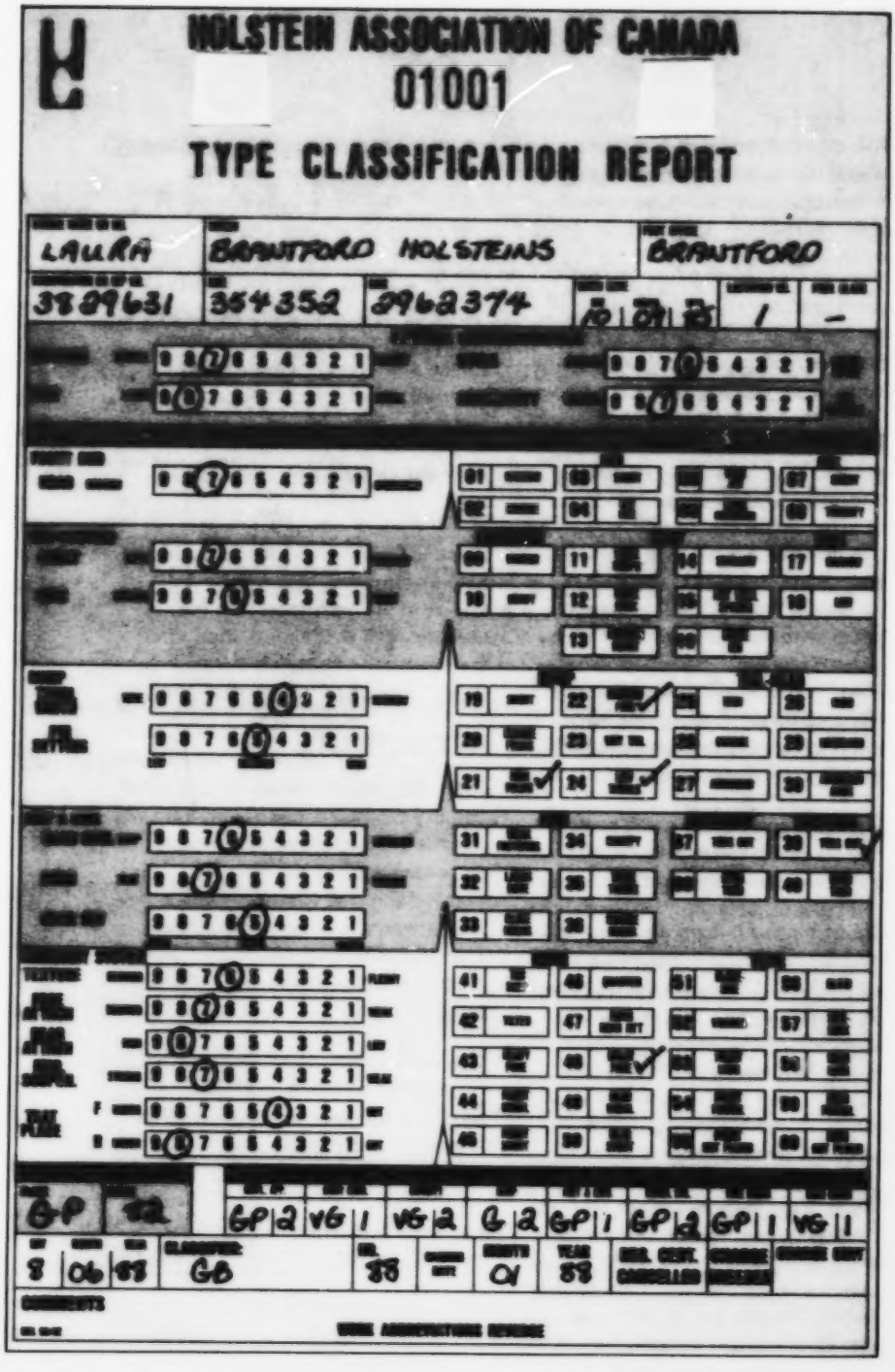


Figure 8 A type-classification form of the kind completed by hand. As of mid-1988, a small hand-held computer prints the report forms right at the farm. The new form looks somewhat different but contains the same information.

MILK PRODUCTION

The BCA system

Breed Class Averages (BCA's) compare the production of cows of different ages that calve in different months — for example, the production of a 24-month-old cow calving in July to that of one 78 months old calving in November.

The principle is simple. Each production record is expressed as a ratio of the average production of cows of the same age calving in the same month, multiplied by 100. However, because the standard used to calculate BCA is the average for the population of Canadian Holsteins in 1949-52, the average BCA of a cow that calved in 1987 is not 100, but closer to 149 for milk and 147 for fat. The difference reflects the progress in both selection and management that has occurred.

There is a separate BCA standard for each age and month of calving. Table 2 shows examples of these for three ages. Using the table, the BCA rating of a 24-month-old cow calving in July with a 305-day yield of 5000 kg would be:

$$\frac{5000}{3823} \times 100 = 131$$

A 48-month-old cow calving in September with the same production record would have the following rating:

$$\frac{5000}{4846} \times 100 = 103$$

BCA standards for butterfat have been used as long as the milk standards have; those for protein have been available in Canada since January 1985.

Table 2 BCA Milk Production Standards for Holsteins (kg)

AGE IN MONTHS	MONTH OF CALVING					
	JAN.	FEB.	MAR.	APR.	MAY	JUN.
24	4060	4013	3964	3908	3856	3857
48	5017	5005	4961	4890	4852	4760
84	5467	5408	5322	5236	5176	5095
AGE IN MONTHS	**JULY**	**AUG.**	**SEP.**	**OCT.**	**NOV.**	**DEC.**
24	3823	3862	3970	4077	4095	4092
48	4699	4702	4846	4998	5048	5045
84	5032	5083	5254	5449	5526	5500

Source: Holstein Canada

Figure 9 shows a certificate of production to illustrate some of the ways in which BCA is used. It expresses a cow's production as her BCA index (i.e., milk 144, fat 152, protein 144) and as a deviation in BCA points from the average production of her herd (i.e., milk +6, fat +8). Her genetic merit, or cow index, is also expressed in BCA's (i.e., milk −1, fat −1).

Note, however, that BCA'S adjust records for age and season of calving but not for other factors. Therefore, production records in BCA (BCA index + deviation from herd average) do *not* reflect the genetic merit of an animal as sire proofs and cow indexes do.

Sire proofs

In Canada, sires are evaluated for production by how their daughters compare with all other cows by other sires in the same herd, in an Animal Model.

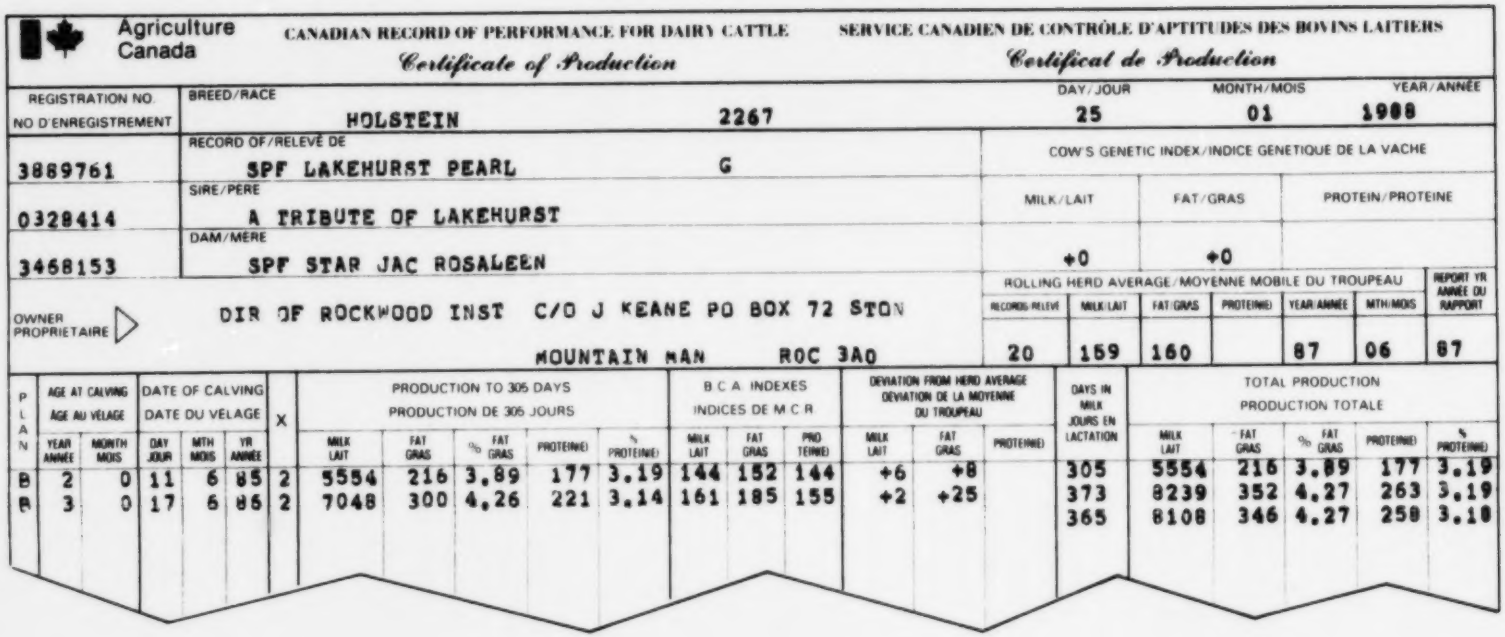
RECORDS USED Records used in computing sire proofs must have been completed or in progress for at least 90 days; they can be from herds on official test or from unofficial herds that meet requirements for monitoring and animal identification. In-progress records are given weights of less than 1 to indicate that they are less accurate than completed ones. The Animal Model accounts for selection between lactations, allowing all production records to be used.

ADJUSTING FOR NON-GENETIC FACTORS A proof isolates the sire's genetic contribution to his daughters' production. However, many other factors affect production and must be taken into account.

The Breed Class Average system adjusts all records for age and month of calving.

The BCA of each lactation of each daughter of a bull is compared to the BCA of the corresponding lactations of all other cows in the same herd that calve in the same herd-year season (there are two herd-year seasons based on month of calving, March to August and September to February).

Figure 9 A certificate of production showing some of the ways BCA is used



Agriculture Canada

CANADIAN RECORD OF PERFORMANCE FOR DAIRY CATTLE — *Certificate of Production*

SERVICE CANADIEN DE CONTRÔLE D'APTITUDES DES BOVINS LAITIERS — *Certificat de Production*

REGISTRATION NO. / NO D'ENREGISTREMENT	BREED/RACE		DAY/JOUR	MONTH/MOIS	YEAR/ANNÉE
	HOLSTEIN	2267	25	01	1988

	RECORD OF/RELEVÉ DE		COW'S GENETIC INDEX/INDICE GENETIQUE DE LA VACHE		
3889761	SPF LAKEHURST PEARL	G	MILK/LAIT	FAT/GRAS	PROTEIN/PROTEINE
0328414	SIRE/PERE A TRIBUTE OF LAKEHURST				
3468153	DAM/MERE SPF STAR JAC ROSALEEN		+0	+0	

OWNER / PROPRIETAIRE ▷ DIR OF ROCKWOOD INST C/O J KEANE PO BOX 72 STON MOUNTAIN MAN ROC 3A0

ROLLING HERD AVERAGE/MOYENNE MOBILE DU TROUPEAU						REPORT YR / ANNÉE DU RAPPORT
RECORDS/RELEVÉ	MILK/LAIT	FAT/GRAS	PROTEIN/PROTEINE	YEAR/ANNÉE	MTH/MOIS	
20	159	160		87	06	87

PLAN	AGE AT CALVING / AGE AU VÊLAGE		DATE OF CALVING / DATE DU VÊLAGE			X	PRODUCTION TO 305 DAYS / PRODUCTION DE 305 JOURS					B.C.A. INDEXES / INDICES DE M.C.R.			DEVIATION FROM HERD AVERAGE / DÉVIATION DE LA MOYENNE DU TROUPEAU			DAYS IN MILK / JOURS EN LACTATION	TOTAL PRODUCTION / PRODUCTION TOTALE				
	YEAR / ANNÉE	MONTH / MOIS	DAY / JOUR	MTH / MOIS	YR / ANNÉE		MILK / LAIT	FAT / GRAS	% FAT / GRAS	PROTEIN(E)	% PROTEIN(E)	MILK / LAIT	FAT / GRAS	PRO. TEINE)	MILK / LAIT	FAT / GRAS	PROTEIN(E)		MILK / LAIT	FAT / GRAS	% FAT / GRAS	PROTEIN(E)	% PROTEIN(E)
B	2	0	11	6	85	2	5554	216	3.89	177	3.19	144	152	144	+6	+8		305	5554	216	3.89	177	3.19
B	3	0	17	6	86	2	7048	300	4.26	221	3.14	161	185	155	+2	+25		373	8239	352	4.27	263	3.19
																		365	8108	346	4.27	258	3.18

The method employed is the Best Linear Unbiased Prediction (BLUP) using an Animal Model. The mathematical model considers effects due both to sire groups and to sires within groups. It treats the sires within a group as a random sample from a large population. The groups are defined in terms of whether the sires were used for artificial insemination or not, and on the first year in which the sires' daughters calved. Relationships between sires and the genetic merit of their dams are considered, and it is assumed that heritability is 0.25 for milk yield and for fat yield.

The BLUP-Animal Model methodology avoids one of the greatest weaknesses of contemporary comparison techniques. It does not assume that the average genetic merit of other bulls used or the genetic merit of dams in the same herd is zero; rather, by solving for sire values across all herds simultaneously, it determines the actual merit of those other bulls. Hence, if a bull's daughter has the same BCA as her herdmates whose sires are found to be superior and, if her dam is of average genetic merit, her contribution to her sire's proof will be a positive value rather than zero. The BLUP-Animal Model methodology has other important statistical advantages, making it the world's most advanced technique at present.

ROLLING BASE The BLUP-Animal Model methodology estimates differences in bulls' genetic merit. Therefore, it is necessary to define a base or zero point from which bulls' evaluations can be expressed as deviations. Since 1983, proofs have been computed using a rolling rather than fixed base so that they reflect a more up-to-date comparison with the current population of bulls. The genetic merit of individual sires has not changed; only the base for reporting them.

The rolling base is the average index of cows calving for the first time in the previous 5 years (see cow indexes). This base index is deducted from the proof value determined for each currently proven bull.

At the current rapid rate of genetic gain, proofs on proven bulls will decrease by close to one BCA point per year. It is essential, therefore, to quote the most recent evaluation of a bull that has been evaluated several times. In all official proof publications, extended pedigrees and advertisements the year of calculation is shown with the proof (e.g., Sire A — DSC '87. . .).

REPEATABILITY The repeatability statistically measures the accuracy of a bull proof. The scale ranges from 30 to 99%. Repeatability depends on the number of daughters compared, the number of herd-year seasons in which the comparisons occurred, and the number of contemporaries involved in the comparisons. The higher the repeatability, the more accurate the proof. A proof is official and published only when the repeatability of a sire is 55% or higher and there are daughters in five or more herds.

Twice a year, Agriculture Canada generates the official sire production proofs. In the fall of 1988, the department computed milk and fat proofs for 1353 Holstein bulls and protein proofs for 1244.

RANGE OF PROOFS Production proofs for bulls range from about +21 to −21 BCA.

The evaluations for milk, fat and protein are in terms of BCA's expressed as deviations from the average of the moving base group. Thus, the daughters of a +5 milk bull should, on average, outproduce the daughters of a −4 bull by 9 BCA points, but only if all other factors influencing production are the same for the daughters of both bulls. In reality, herd conditions, etc., always remain major influences.

CONVERSION TO KILOGRAMS OR POUNDS BCA evaluations may be converted from kilograms or pounds. Agriculture Canada has established conversion values; to get this Mature Equivalent rating:

- For milk, multiply the BCA rating by 117 to get pounds and by 53 to get kilograms;
- For fat, multiply the BCA rating by 4.32 to get pounds and by 1.96 to get kilograms;
- For protein, multiply the BCA rating by 3.77 to get pounds and by 1.68 to get kilograms.

These factors are used to convert genetic evaluations for sire proofs and cow indexes. They should *not* be used to convert production records in BCA of *individual* cows.

SIRE PROOF PUBLICATIONS Agriculture Canada publishes two sire lists. One lists all proven bulls with semen available or with new daughters since the last evaluation. The other lists only AI bulls with semen available and ranks the top 35 bulls for fat proof, protein proof and milk proof.

Figure 10 is a sample page from the first listing. This direct comparison lists, for each sire, the average milk production of his daughters in BCA terms and their percent milk and fat. Based on the BLUP-Animal Model evaluation, it then shows:

- the number of compared daughters;
- the number of herds;
- the bull's repeatability;
- the bull's proof for milk yield;
- the bull's rank for fat yield in the group of bulls proven this time;
- the bull's proof for fat yield; and
- the bull's proof for percent fat.

For protein, the comparison shows:

- the number of compared daughters;
- the number of herds;
- the bull's repeatability;
- the bull's proof for protein yield; and
- the bull's proof for percent protein.

Finally, it gives the proof of the bull for milking speed and (at top of page) the number of bulls evaluated. As the Animal Model lets all production records be considered, future sire lists will note the number of records used.

Compared daughters are cows that have contemporaries in the same herds, so they can be used in genetic evaluation. The number of compared daughters also reflects the number of records in progress in the proof because these received a weight of less than 1. This explains why the number of daughters can be lower than the number of herds in the proof of a young bull if most of his daughters have incomplete lactations.

Holstein Canada publishes other lists of bulls. These rank the animals by proof for milk yield, fat yield, protein yield and type ratings. Twice a year, the association mails *Who's Who in Canadian Holstein Sires* to subscribers. This gives similar data, as well as complete type proofs, for the same bulls.

Cow indexes

While producing the sire proofs, Agriculture Canada uses the Animal Model to generate a simultaneous cow index for each cow on official test that has contemporaries. The calculations use all available official records for each cow. The index ranks cows on genetic merit for milk, fat and protein yields, as well as for percent fat, percent protein and repeatability.

Because a bull has a large number of daughters, it is possible to estimate his genetic merit with a high degree of accuracy. A cow rarely has more than a few records and few offspring, so estimates of her merit are less accurate. They are based more upon her pedigree and her own records than on her actual pattern of transmission, although her daughters are certainly considered.

Figure 10 A sample page from a sire proof publication that makes direct comparisons between sires.

HOLSTEINS CANADIAN A.I. DAIRY SIRE COMPARISON AUGUST 1988 LIST BY NAME
COMPARAISON CANADIENNE DES TAUREAUX LAITIERS D'I.A. AOUT 1988 LISTE ALPHABETIQUE

SEMEN AVAIL. SER. DISP.	SEMEN CODE / CODE DE LA SEMENCE	NUMBER / NUMERO	NAME / NOM	MILK AND FAT/LAIT ET GRAS: DAUS FIL.	HERDS TROUP	REP MILK REP LAIT	BCA MCR MILK LAIT	BCA MCR FAT GRAS	%FAT %GRAS	PROTEIN/PROTEINE: DAUS FIL.	HERDS TROUP	REP	BCA MCR PROT PROT	%PROT %PROT	MS VT
2	71H03300	335966	GLENRIDGE CITAMATT	8266	2239	99	-3	-1	0.08	6546	1920	99	-2	0.03	AV
2	89H00042	361833	GLENSTOR ASTRO ROCK ET	155	78	89	8	1	-0.19	154	77	89	5	-0.07	AV
2	69H00041	361834	GLENSTOR BARON ET	29	18	68	-6	8	0.41	29	18	68	-1	0.12	
1	73H00759	374336	GRASSHILL CASA BLANCA ET	54	54	78	15	10	-0.13	54	54	78	14	-0.01	
1	39H00210	374341	GRASSHILL CASANOVA ET	77	67	82	0	9	0.27	77	67	82	0	0.01	
1	73H00777	376107	GRASSHILL COUNTDOWN	39	40	72	3	4	0.00	39	40	72	6	0.07	
2	89H00030	355379	GRASSHILL ELEVATION MATHEW	422	211	95	-9	-1	0.24	403	203	95	-8	0.01	AV
2	69H00023	345211	GRASSHILL MAGIC MAN	232	83	92	-7	3	0.29	140	56	88	-5	0.07	F
2	70H00311	372907	GRASSHILL MAVERICK ET	54	53	77	3	-2	-0.14	54	53	77	2	-0.02	
1	72H00456	375355	GRASSHILL MR MATCHMAKER	16	17	56	5	7	0.05	16	17	56	4	-0.01	
1	71H00782	375217	HANOVER HILL COUNSELOR-ET	55	51	77	-2	4	0.18	55	51	77	-1	0.03	AV
2	94H00104	363974	HANOVER-HILL AMBASSADOR-ET	44	31	73	-5	-2	0.09	43	31	72	-6	-0.02	
1	72H00376	363162	HANOVER-HILL INSPIRATION	164	126	89	13	13	-0.02	164	126	89	13	0.00	AV
1	73H00586	362965	HANOVER-HILL SWD DAGGER ET	68	62	81	11	10	-0.03	67	61	81	14	0.08	
1	71H00757	370799	HANOVERHILL DESIGNER	161	133	90	1	9	0.22	161	133	90	6	0.11	AV
1	28H00145	370800	HANOVERHILL HIGHCROFT	62	36	79	5	1	-0.13	62	36	79	1	-0.11	
1	70H00279	365515	HANOVERHILL JETHRO	74	65	82	4	1	-0.08	74	65	82	5	0.03	AV
1	70H00321	375740	HANOVERHILL NUGGET	28	26	67	-1	-5	-0.09	28	26	67	-1	0.00	F
1	94H00114	367242	HANOVERHILL PROFIT-ET	86	38	82	-1	4	0.14	86	38	82	-2	-0.02	AV
1	71H00800	373367	HANOVERHILL RENEGADE	60	57	79	7	10	0.07	60	57	79	5	-0.03	F
2	70H00307	373364	HANOVERHILL REPLY-ET		58	81	-1	-7	-0.19	67	58	81	-1	-0.02	F
	70H00320	371447	HANOVERHILL ROYALIST ET			75	2	10	0.23	46	49	75	4	0.04	AV
			HILL SABAST					12	0.15			88	10	0.09	
													5		

The information on the cow's performance and that of her relatives is weighted according to its accuracy and to each relative's relationship to her. For instance, if a proven bull had sired the cow, the sire proof would receive a high weighting.

All relatives in the cow's herd are considered — her sire, maternal grandsire, dam, maternal siblings and daughters in the same herd — based on their BCA deviations from herd average, adjusted for days open. The index also takes into account her proven sons, if any. When a cow has records and relatives in more than one herd, her index is based on information from all the herds.

As a simplified example, suppose that the information available is:

cow's deviation (two lactations)	+10
sire proof (200 daughters)	+ 6
dam deviations (five lactations)	+40
maternal grandsire proof (25 daughters)	+ 2
maternal grand-dam (four lactations)	− 6

Each of these is given an appropriate weight, e.g.:

Cow index = 0.123(+10)
+ 0.378(+6)
+ 0.066(+40)
+ 0.123(+2)
+ 0.025(−6)
= + 6.24 (or +6)

Pedigree indexes

Holstein Canada calculates pedigree indexes for animals that do not yet have an official prcof or cow index. They are based entirely upon ancestry information. As in the case of the cow index, the contribution of each ancestor to the value of an animal's pedigree index depends upon the closeness of the relationship and the accuracy of the information. Under normal circumstances, it will approximate the mean of the sire's proof and the dam's cow index.

What are proofs and indexes worth?

A cow's production reflects many things, most of which are not genetic in origin — her feeding program, herd management, the climate in which she lives, etc. An evaluation based on raw performance information considers only the circumstances under which she lives and her genetic merit. If she moves to another herd or country, her new performance will largely reflect her new conditions.

By taking so many influences into account, cow indexes have proven of great use. Those cows that merit higher cow indexes or pedigree indexes tend to outperform lower-rated cows in equal circumstances, whether under poor or ideal management. Although cow indexes are not as accurate as sire proofs, they are certainly the best single measure currently available to show an animal's worth.

Wise breeders pay careful attention to a cow index, but they consider many other factors as well. The cow index has made it easier, but not simple, to select females for productive genetic merit.

Sire proofs, by contrast, are highly accurate. Reference to the production of a bull's dam, for example, will produce a much less accurate judgement of the bull's merit than will use of his proof alone.

Cow index publications

TOP PRODUCER LIST After the cow indexes are calculated every 6 months, Agriculture Canada ranks the top 0.5% of the cows in the Holstein breed according to their genetic index for butterfat yield. Each cow is given a percentile ranking.

ELITE COW LIST This Agriculture Canada publication lists cows that are outstanding in both production and type classification. There are two lists; one lists cows by herd number, the other by sire number. Both lists are divided into mature cows and 2-year-olds.

ELITE COW DIRECTORY Holstein Canada adds further information to the preceeding lists (e.g., names and genetic indexes of sires and dams and some phenotypic information) and lists the animals by province and by herd. The directory is published for use by AI units and other potential purchasers of embryos or offspring.

TYPE CLASSIFICATION

In Canada, a sire proof for conformation, as for production, is a BLUP-Animal Model estimate of a sire's genetic transmitting ability based on the latest classification for all females.

Heritability

Traits vary in the degree to which they may be inherited. Table 3 shows the heritability estimates for the major traits that have been established in the Canadian system. These estimates are assumed in both sire and cow genetic evaluation procedures.

Objective scores

For accurate genetic evaluations, figures compiled by classifiers at the farm must be converted into a format that can be used in the calculation model. The distribution curves of linear scores for the various characteristics differ greatly and are not smooth. The Snell method is used to assign a weight to each individual daughter's evaluation from the actual distribution of scores. The resulting objective scores for each trait are on a scale of 1–100.

Table 3 Heritability Estimates for Scorecard Breakdown, Traits, Size and Stature

TRAIT	ESTIMATES
Final class	0.17
General appearance	0.14
Dairy character	0.19
Capacity	0.29
Rump	0.16
Feet and legs	0.10
Mammary system	0.15
Fore udder	0.14
Rear udder	0.14
Size	0.39
Stature	0.39

Source: Holstein Canada

Eliminating bias

Five factors have the potential to bias genetic evaluations. To remove such biases, the relative significance of each is determined and their objective scores adjusted. The herd-visit effect is most significant, followed by age and relationship matrix. Dam and stage of lactation effects are minimal.

HERD-CLASSIFIER VISIT Producers differ in how they manage herds and present cows to the classifier. Classifiers often adjust standards slightly between rounds; different animals in one herd become eligible for classification on different visits. These differences are the greatest cause of variation in classifications.

Therefore, cows that were first classified together in the same herd, by the same classifier and on the same visit are defined as a group. Each is compared to the average of that group, even if later reclassified.

AGE AT CLASSIFICATION Mammary systems, legs and feet tend to change negatively with age while stature and capacity become more desirable. However, classifiers do not often adjust for age. As a result, younger first-lactation cows tend to classify lower than older first-lactation cows do. Adjustments for age are needed to standardize the classifications.

RELATIONSHIPS BETWEEN SIRES The relationship matrix for a bull shows, graphically, his existing relationships to other sires. Type classification information on the bull's relatives is used, particularly proofs of the sire and maternal grandsire. The effect of the matrix may be major if a bull has few daughters, but will be minimal once he has 60 or more.

STAGE OF LACTATION Ten categories (1 month to 10 or more months) exist. The effect is very minor except for an animal that has calved less than 2 or more than 5 months earlier.

GENETIC MERIT OF THE DAM The effect of the dam is accounted for by adjusting the daughter's type evaluations based on the genetic merit of the dam. Generally the effect of the dam's merit is minor.

Calculating a sire proof

The proof is the sum of the weighted factors, determined simultaneously using BLUP-Animal Model technology. A separate proof is calculated for each trait:

Sire proof = daughters' average deviation + age adjustment
+ stage of lactation adjustment
+ dams' regression adjustment
+ herd-visit adjustment
+ relationship matrix adjustment

An example:

Sire A: 341 daughters in 150 herds

Final class = +5.7 − 2.0 + 1.2
+ 0.1 + 1.4 − 0.6
= +5.8 (or +6)

This sire's proof shows that his daughters, as a group, were above average for type (+5.7), older than average at first classification (−2.0), early in lactation, when cows classify lower (+1.2), slightly below breed average for type (+0.1) and slightly superior to herdmates at first classification (+1.4). It reveals that the information on this bull's relatives calls for a downward adjustment of 0.6 on the proof obtained from daughter records.

ROLLING BASE Sire proofs and cow indexes for type are calculated on a moving base or rolling average of all females first classified during the five latest classifier rounds. This base is set at 0. Thus, a sire who receives a "plus" for a particular trait has the potential to improve that trait in the breed.

REPEATABILITY A sire receives an official proof only if he has daughters in at least five herds and a repeatability of 55% or better for final class. Repeatability reflects the number of daughters, the number of herds in which they occur and the heritability of the trait. For equal accuracy, traits of low heritability require larger numbers of daughters than do ones of high heritability.

RANGES Proofs for final class range from +18 to −20. Those for scorecard parts and individual descriptive traits (except set of rear legs and pin settings) range from approximately +20 to −20.

The standard deviation of each trait is 5. Proofs above +5 indicate that the bull is a definite improver for the breed.

For the two traits scored to the midpoint (set of rear legs and pin setting) proofs range from +20 to −20. A bull receiving a proof less than +5 has a letter indicating a tendency added to his proof.

- Legs: C (curved), S (straight), V (variable)
- Pins: H (high), L (low), V (variable)

The V (variable) describes a bull for whose daughters a clear tendency cannot be determined.

Sire proof publications

Each February and August, the University of Guelph compiles sire type proofs that the Holstein Association publishes. Each sire receives an individual analysis for type when he receives his first official proof. This gets updated each time he has five new daughters or five reclassified daughters in his proof.

Holstein Canada sends, to subscribers, *Sire Analysis for Type for newly proven bulls*, as well as *Who's Who in Canadian Holstein Sires* (mentioned previously).

The new BLUP-Animal Model methodology

As for production, the Animal Model increases the accuracy of the type proofs, and produces cow indexes for type at the same time. However, it keeps enough of the traditional system that proofs look similar.

ESTIMATED TRANSMITTING ABILITY In Canada, the genetic merit of a cow or bull, expressed in relative terms, is an Estimated Transmitting Ability (ETA). To convert this to an Estimated Breeding Value (EBV), multiply by 2.

OTHER TRAITS

MILKING SPEED As mentioned, some milk recording programs collect subjective data on milking speed from the owner. The University of Guelph, with funding from Agriculture Canada, uses this data to provide proofs for this characteristic. Sires must have 55% repeatability for milking speed to receive an official proof.

The evaluations are determined by the BLUP-Animal Model system and account for parity or lactation number, stage of lactation, age of cow, test-day milk yield, herd variation in a specific year and season of calving.

The ratings are very fast (2%), fast (14%), average (68%), slow (14%) and very slow (2%). Breeders prefer the average rating as a very fast milking speed sometimes leads to milk loss (leaking) and mastitis.

CALVING EASE The University of Guelph and MacDonald College calculate and publish sire proofs for calving ease for Ontario and Quebec, respectively, but national figures are not available.

The evaluations are adjusted by the BLUP-Animal Model system for lactation number and size of dam, sex of calf, relationship between sires and seasonal (winter/summer) effects.

The ratings are easy (16% — approximately 6–9 hard pulls per 100 calvings), average (68% — approximately 11–12 hard pulls) and difficult (16% — approximately 16–22 hard pulls). Breeders prefer average or easy ratings. Both extremes have disadvantages — difficult for obvious reasons and easy because resulting calves often are small and may encounter difficulties when they calve themselves.

Figure 11 A pages from Who's Who in Canadian Holstein Sires

NAME OF SIRE NOM DU GENITEUR	Group Code Code de groupement	Type	Sire Award Reconnaissance des geniteur	Rec Merit Merite Inscrit	Spec Appeal Sujet Avantage	PRODUCTION Actual avg 2 Yr lact Moyenne réele de 2 ans lacts			Direct Sire Comparison Comparaison directe des géniteurs							CLASSIFICATION Actual/Actuelle						
						Milk Kg Lait Kg	% Fat % Gras	% Prot % Prot	Daus Filles	Yr An	Rept	Milk BCA Lait MCR	Fat BCA Gras MCR	% Fat % Gras	Prot BCA Prot MCR	% Prot	EX	VG 1B	GP 2P	G 3	F - P	Total No No Total	% Better Than
MONTFRECH SYDNEY	73	VG			S	6364	3.5	3.0	44	86	74	+7	+3	-.14	+2	-.13		4	25	22	2	53	55
MONTMAPLE ENDEAVOUR	0	VG				6579	3.6	3.2	45	86	85	+4	-2	-.18	+3	-.04		4	23	18	2	47	57
MOOREVILLE CITATION CHARLES	89	VG				5504	3.6	3.1	97	86	84	-4	-5	-.03	-5	-.03			30	46	6	82	37
MOOREVILLE CITATION TAURUS	72	VG		Y		5977	3.5	3.0	105	86	85	+3	-5	-.23	0	-.09		7	44	55	6	112	46
MOOREVILLE EMPEROR PERSEUS	72	GP	ST'83			5805	3.8	3.1	728	86	97	-4	-6	+.02	-7	-.06		15	334	385	36	770	45
MOOREVILLE PRESTO	73	VG				5203	3.7	3.2	43	86	73	-7	-7	.00	-6	.00		4	30	10	0	44	77
MORROWDALE GOVERNOR	89	VG				5676	3.6	3.2	33	86	70	-7	-7	+.01	-6	+.02			13	12	0	25	52
MORVILL PATRICK	89	VG			S	5590	3.8	3.2	42	86	72	-5	-3	+.08	-4	+.04		1	20	29	2	52	40
MOUNT AIRY HYLITE	73	VG	ST'82		S	6321	3.5	3.2	812	86	97	+2	-2	-.14	+5	+.06		11	405	432	20	868	48
MOUNT HOPE CITATION JOE	72	VG				5719	3.6	0.0	67	86	80	-2	-6	-.10				4	26	30	6	66	45
MOUNT HOPE CLIMAX	72	GP		Y		5633	3.5	0.0	50	86	74	-4	-11	-.18				7	31	30	3	71	54
MOUNT HOPE DUKE	89	VG		Y		5461	3.8	3.2	89	86	84	-9	-8	+.08	-7	+.03		2	28	56	10	94	30
MOUNT HOPE FLAIR	73	GP				5848	3.6	3.2	45	86	75	0	-2	-.07	0	+.01		1	22	26	2	51	45
MOUNT HOPE FLAVIUS	73	G				5762	3.5	3.1	429	86	95	0	-6	-.16	-3	-.06		19	224	240	22	505	48
MOUNTHOLM MARSHAL	0	VG				0								.00				6	23	7	1	37	78
[illegible]DALE MARQUIS	0	EX				[illegible]												2	[illegible]	[illegible]	2	48	[illegible]

DIFFERENCES FROM BREED AVERAGE FOR TYPE/DIFFERENCES BASEES SUR LA MOYENNE DE LA RACE POUR LE TYPE

					Scorecard Breakdown Répartition Des Points								General Characteristics Caractéristiques Générales				Description of Characteristics Description Des Caractéristiques												
Reg No No ENRG	Daus Filles	Rept	Year Année	Final Class Classe finale	Gen App Aspect gen	Dairy Char Caractéristiques	Cap Cap	Rump Croupe	Feet & Legs Pieds & membres	Mamm sys Syst Mamm	Fore Udder Avant pis	Rear Udder Arr pis	Stat Grandeur	Sale Grossesse	Style Elegance	Dairy ness Caractéristiques	Head Tête	Chest Floor Poitrail	Loin Strength Force rein	Rump Width Largeur Croupe	Pin Setting Placheons	Rear Heat Talon arr	Bone Quality Qualité os	Set of Rear Legs Plac membs arr	Udder Texture Texture pis	Median Susp Susp méd	Fore Attach Attach avant	Rear Attach Attach arr	Fore Teat Placement Trayons Avant	Rear Teat Placement Trayons arr	
351749	52	72	86	+3	+4	+3	-4	+4	-4	+3	+3	+3	-1	-1	+3	+4	0	-2	+8	0	-1L	+2	0	+8S	0	-1	+1	+4	+3	+1	
352292	45	62	86	+4	+4	+4	+2	-3	+1	+6	+2	+7	+2	+2	+2	+3	-4	+3	-7	-7	+4H	+5	+4	-1C	-1	+3	0	+5	0	+1	
331436	57	72	86	-8	-8	+4	-10	-4	+6	-8	-8	-6	-9	-10	-7	+2	-8	-13	-11	-1	+0H	0	+13	+16	+3	0	-6	-5	-1	-1	
325211	43	68	86	0	0	+8	-4	+5	+5	-3	-5	+1	0	-1	0	+7	-4	-3	+2	-3	+1B	+2	+8	+8C	+2	+1	-5	+1	-1	+1	
332807	859	96	86	+3	+3	-9	-3	+5	+5	+4	+5	+4	-2	-2	+2	-9	-2	-3	-1	+1	+4H	+4	0	+8C	-4	+2	+6	+3	-1	+1	
338204	43	68	85	+5	+5	+1	-4	+7	+3	+8	+2	+9	-3	-3	+6	0		-1	-3	+5	+8H	+1	+6	-5C	+3	+6	+3	+9	+6	+6	
350035	25	59	86	+5	+4	-2	0	-5	+6	+5	+7	+3	0	0	+3	-1	+5	+3	-3	-2	+0H	+7	+3	+12C	+3	+5	+8	+6	+6	+3	
342413	52	71	86	-2	-1	-3	-1	-5	-1	0	+3	-3	-6	-6	-5	-4	-1	-2	-7	0	+12L	-9	+3	-5C	+2	-2	+1	-3	+2	0	
340792	651	96	86	+5	+5	+2	+5	0	+9	+1	-3	+6	+8	+6	+6	+2	-4	+4	-1	0	+0L	-2	+9	+0S	+4	+7	-7	+7	+2	+10	
331534	64	75	85	0	0	+2	-2	+7	+3	-2	0	-2	+1	+3	0	+2		+1	-3	+8	+8L	-3	+3	+12C	+1	-2	-3	-1	-1	-1	
328642	70	78	85	+3	+3	+2	-1	+9	+2	+1	0	+4	+5	-4	+3	+5		-8	+8	+1	-4L	+1	+1	+8C	+4	-1	0	+1	-5	-8	
347285	92	80	86	-8	-7	-4	-2	-5	+6	-6	-9	-3	-2	-3	-4	-5	-9	-7	-5	-3	+12H	+1	+3	+0C	+1	-2	-1	-1	-10	-8	
344599	51	71	86	-4	-1	-3	-3	-4	+9	-3	-3	-1	-3	-4	0	-4	+2	0	+1	-3	-1H	+3	+4	+20	+1	+1	-2	-1	-4	-3	
326838	417	94	86	-2	-2	+8	-6	+5	+5	-7	-12	-2	+4	0	0	+9	+1	-11	-10	+1	-5H	-10	+16	-8C	+12	-2	-10	+3	-8	-6	
323019	30	60	85	+2	+4	+2	-6	-2	+9	+3	0	+4	-2	-3	+5	+2		-2	-3	-5	+12L	+2	+7	+4C	0	+3	+2	+2	0	-2	
[illegible]3570	39	66	85		-6	-6	-2	-2	-9	-4	[illegible]		[illegible]	-2	-3	-6															
	671	96					-3	+1	-5																						

Holstein Canada's Breed Improvement Strategy

The ideal cow gives its owner the best possible returns. In genetic terms, it has maximum merit in the most important traits.

Holstein Canada aims for an annual genetic gain of 0.75% for the sum of the primary traits (milk yield and conformation), based on an improvement of 1% per year for each primary trait. At the same time, the association tries to hold secondary traits at their existing level or increase them up to 0.25% per year, while monitoring other traits to ensure the population does not deteriorate.

TRAITS

The association considers only traits that have a major influence on profitability as primary — milk yield (individual lactation and lifetime yield) and body conformation (as expressed in final type classification).

Holstein Canada wishes to increase percent protein at an annual rate of 0.005% and to maintain percent butterfat at 3.7%. The association considers these as secondary traits because they do not require improvement as much as the primary traits do and selection for percentage of components leads to lower milk yield gains.

The association continues to improve conformation of the mammary system, rump, legs, shape and depth of feet, and dairy character in relationship to capacity.

Other traits that Holstein Canada monitors in the population include milking speed, calving ease, body size and heritable defects. In the future, it plans to monitor feed efficiency, disease resistance, temperament and fertility.

At the time of writing, Holstein Canada is studying the relative emphasis on traits with a view to giving more importance to protein yield.

THE IDEAL HOLSTEIN HERD

An ideal herd has certain characteristics:

- The calves are free from defects and diseases at birth, need minimal veterinary care and grow rapidly.
- From birth to first calving, only 5% of heifers die.
- Heifers are reared according to the maximum use of forage.
- Heifers have sufficient stature and size to be bred at 15 months of age.

Figure 12 True-type Holstein cow

- At first calving, heifers are no more than 27 months old. At this time, they are at least 137 cm tall and weigh at least 550 kg.
- Females produce a live calf every 12–13 months.
- The number of heifers reared annually to breeding age is 40% of the number of milking cows. Surplus heifers can then be sold or used within the herd to accelerate genetic improvement.
- Cows can complete at least six lactations.

SIRE SELECTION AND USE

About 92% of the genetic gain in Canadian dairy cattle arises from the sire selection system used for AI. The critical limitations are the percentage of the cow population used to sample young sires, and the intensity with which the young sires are selected for testing and with which the proven sires are selected for use. The accuracy of the sire proof system also plays a very important role.

Cow population used to sample sires

Holstein Canada recommends that at least 20% of all first AI inseminations (i.e., to both cows and virgin heifers), including those from private tanks, be from young bulls in the progeny testing program. To maximize genetic improvement, inseminations should be in herds where all performance information is collected and is useful for sire proving. In recent years, many AI units have surpassed 20% by a significant margin.

Progeny testing

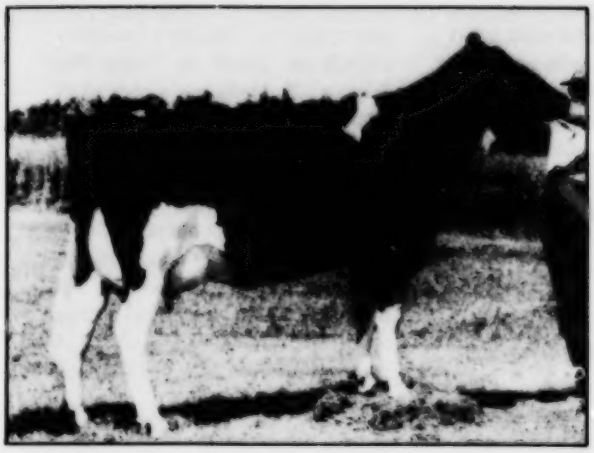
GENETIC MERIT Holstein Canada recommends that:

- sires of the young bulls be chosen from the top 15% of proven sires for both milk yield and conformation, or from the top 5% for either milk yield or conformation and from the top 30% for the other primary trait;
- dams meet the same standards from within the cow population (cow families, generation interval and longevity should be considered in their selection);
- adequate selection pressure be placed on secondary and other traits to achieve the association's goals;
- on rare occasions, bulls that do not meet the criteria but are good "breeder's choices" be included; and
- parents be ranked within the population in which they are first evaluated.

NUMBER OF BULLS PROGENY TESTED EACH YEAR Assuming that it takes 400 first services to test each bull, Holstein Canada recommends that, each year, an AI unit test a number of a young bulls at least equal to:

$$\frac{0.2\ (\text{total first services})}{400}$$

$$\text{e.g.,}\ \frac{0.2\ (100\ 000)}{400} = 50$$



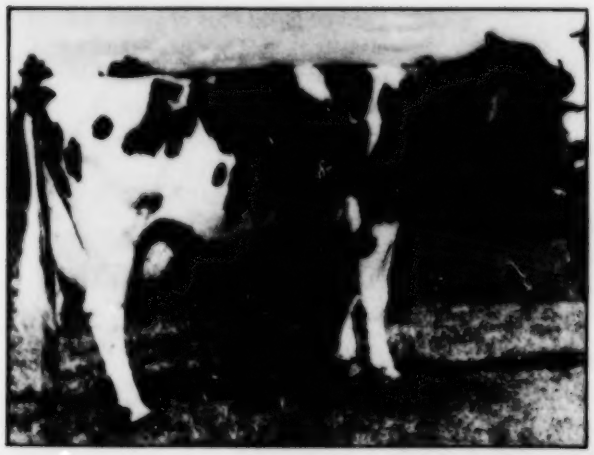
2nd Lactation

CLASS	SCORE		GEN. APP.	DAIRY CHAR.	CAPACITY	RUMP	FEET & LEGS	REAR LEGS SIDE	FORE UDDER	REAR UDDER
GP	83		GP 3	VG 2	GP 1	GP 3	GP 3	GP 3	GP 2	VG 1

DAY	MONTH	YEAR	CLASSIFIER:	NO.	CALVING DATE	MONTH	YEAR	REG. CERT. CANCELLED	CHARGE BREEDER	CHARGE UNIT
10	06	85	DLH	70		04	85			

COMMENTS

WORK ABBREVIATIONS REVERSE



3rd Lactation

CLASS	SCORE		GEN. APP.	DAIRY CHAR.	CAPACITY	RUMP	FEET & LEGS	REAR LEGS SIDE	FORE UDDER	REAR UDDER
GOOD	77		G 2	VG 1	VG 1	G 2	GP 2	G 2	G 1	G 2

DAY	MONTH	YEAR	CLASSIFIER:	NO.	CALVING DATE	MONTH	YEAR	REG. CERT. CANCELLED	CHARGE BREEDER	CHARGE UNIT
10	06	85	DLH	70		10	84			

COMMENTS

WORK ABBREVIATIONS REVERSE

Figure 13 The cow pictured top rated good plus at the fifth month of her second lactation; the other rated good at the seventh month of her third lactation.

THE BREEDER'S ROLE

The entire breed improvement effort depends on members who participate and have the foresight to select and breed genetically superior animals. While the association takes full advantage of science, it still respects the breeder whose unique matings carry the breed to new plateaus of achievement.

U.S. BULLS

Canadian breeders draw stock from the best Holstein populations in the world to ensure the greatest possible genetic development. A large, unrestricted exchange of cattle, semen and embryos exists between the U.S. and Canada. Yet the results are different in the two countries because of different breeding aims.

RESULTS

About 90% of Canada's Holsteins classify as "Good" or "Good Plus" (Figure 13). Many have competed with outstanding success for many years at the World Dairy Expo in Madison, Wisconsin, U.S. (Figure 14).

The butterfat percentage of Canadian Holsteins has not changed significantly in the past 10 years. In 1987, the average fat production of those on official milk recording was 258 kg; the average percentage of fat was 3.65 (308 991 records).

The FAO international trials in Poland, held in 1984, compared Holstein-Friesian strains from 10 different countries. The Canadian strain gave the highest yield by the third lactation.

Canadian breeders value cows that produce well over a long lifetime. Table 5 shows that 93% of longtime high producing Holsteins in Canada average Good Plus or better for type classification. They have outstanding body conformation that lets them perform well year after year.

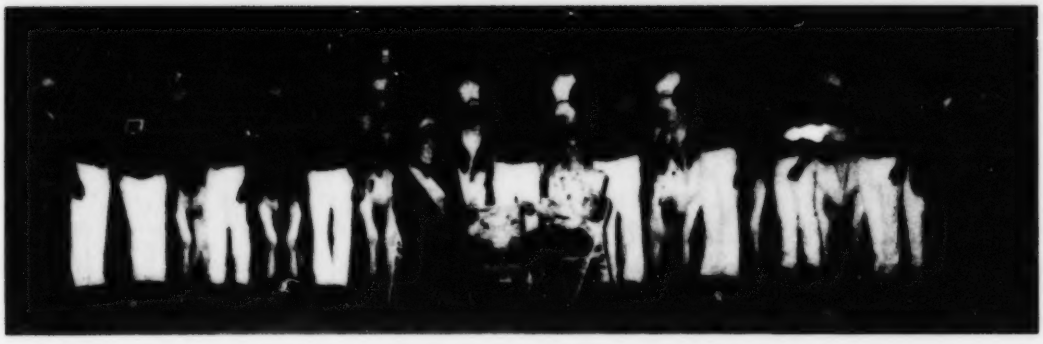


Figure 14 In 1987, exhibitors from the province of Ontario won first prize for the eighth consecutive time in the State Herd competition. The province of Quebec placed third.

Figure 15 The average performance of Holsteins enrolled on official milk recording programs in Canada, showing the phenotypic trend from 1975 to 1986

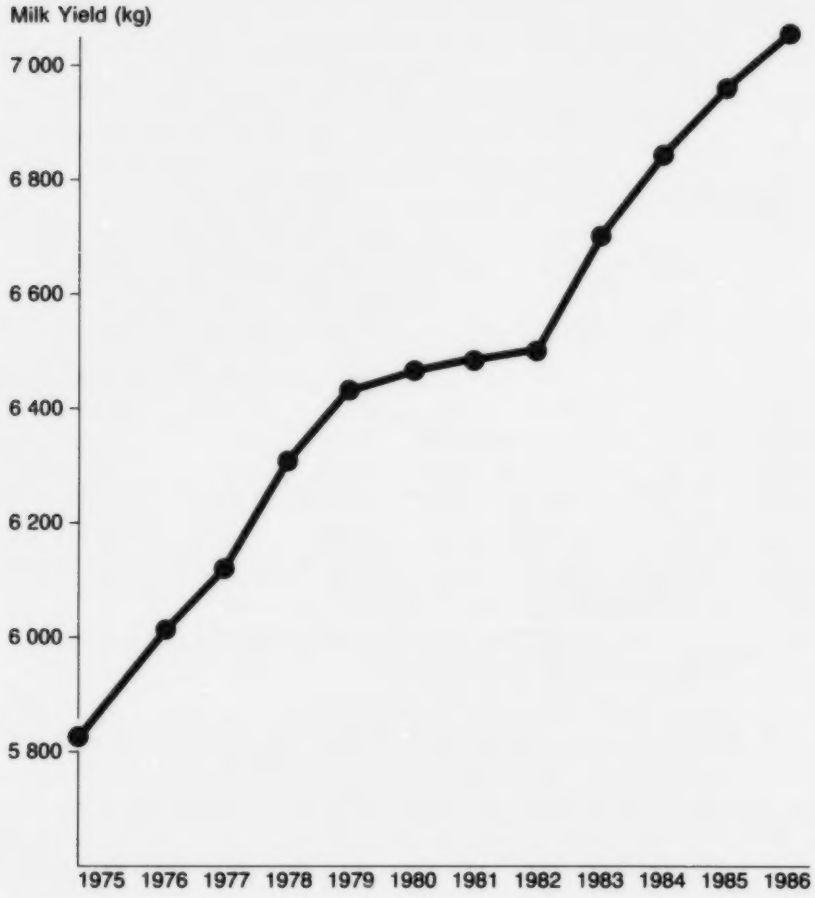


Figure 16 The average first proof of new AI Holstein sires for milk yield, showing the genetic trend from 1977 to 1986

Table 4 Milk and Fat Yields in Three Lactations of F_1 Cows During FAO Trials in Poland (as percentage of those of the Polish strain)

	1st lactation		2nd lactation		3rd lactation	
COUNTRY	**MILK**	**FAT**	**MILK**	**FAT**	**MILK**	**FAT**
U.S.	115.9	113.2	117.7	116.3	113.8	111.6
Israel	113.7	112.2	116.1	116.1	112.9	110.4
Canada	113.2	111.9	117.1	116.6	115.3	113.2
New Zealand	109.5	111.6	110.6	113.5	105.1	107.3
Sweden	105.3	104.7	109.8	110.8	107.1	106.4
U.K.	103.3	102.9	107.6	107.9	106.2	105.6
Denmark	103.2	103.2	103.4	105.4	100.3	99.7
West Germany	102.1	101.0	108.2	107.8	104.6	103.9
Netherlands	99.7	99.9	106.0	106.4	98.2	99.1
Poland	100.0	100.0	100.0	100.0	100.0	100.0

Source: Dr. H.A. Jasiorowski, FAO

Table 5 Cows in Each Selective Registration Class for 1986

LIFETIME PRODUCTION ('000 kg)	COWS	EXCELLENT	VERY GOOD	GOOD PLUS	GOOD	GOOD PLUS & BETTER (%)	VERY GOOD & EXCELLENT (%)
140 and up	—	—	—	—	—	—	—
130–140	—	—	—	—	—	—	—
120–130	1	—	1	—	—	100	100
110–120	12	2	4	4	2	83	50
100–110	42	—	20	21	1	98	48
90–100	103	4	43	52	4	96	46
80– 90	291	9	125	130	27	91	46
70– 80	774	28	308	368	70	91	43
Total	1223	43	501	575	104	93	56

Source: Holstein Canada

The Holstein Association of Canada

In 1884, the Holstein-Friesian Association of Canada was formed and, in 1984, was renamed the Holstein Association of Canada to more accurately reflect the type of dairy cattle bred in Canada today. It is commonly known as Holstein Canada. Operating under a federal charter, it is the only organization authorized to register Holstein cattle in Canada.

To improve the breed, Holstein Canada maintains a herd book and provides breeding information to its more than 15 000 members (a third of the milk producers in the country, owning about 750 000 registered Holstein cows). A non-profit corporation, it receives no direct financial support from government. Fees, particularly those for memberships, calf registrations and transfers of ownership, generate operating funds.

Each year, members elect a board of directors from their own ranks. This board controls and manages association affairs through appointed committees and headquarters and field staff. It employs 120 people, 90 of whom are at the head office.

THE ASSOCIATION'S SERVICES

In the field

COUNTY CLUBS County and district clubs organize Holstein shows, field days and herd management meetings, where association representatives encourage breeders to use type classification and milk recording programs. Representatives also offer management advice to breeders and association branches provide educational and promotional programs. A monthly Holstein Canada news section, in the privately owned *Holstein Journal* magazine, keeps breeders informed of current activities and research.

TYPE CLASSIFICATION PROGRAM The head office administers the type classification program, but 14 classifiers and one technical supervisor work across the country, each covering over 50 000 km/year to classify more than 120 000 animals. They also classify 8000 animals a year in foreign countries. A committee of leading breeders, through its recommendations to the Breed Improvement Committee, advises the classifiers.

In the office

REGISTRATIONS AND TRANSFERS The registration department is the largest in the head office. In 1987, it processed over 149 000 purebred registrations, of which 5272 were for embryo transfer (ET) calves. It also processed over 91 000 Holstein female identifications for the milk recording systems. Transfers of ownership are required only for registered animals, and 53 846 of these were recorded in 1987, 8637 of which were for export. Holstein Canada registers almost as many animals as do all other Canadian registry associations combined.

Breeders must keep complete and consecutive records of all dates of service, with positive identification of females bred and sires used, and of all dates of calving and the sex of the calf. Calves must be positively identified at birth, and an ear tag must be inserted immediately and recorded in the herd records with the date of birth and the dam's name and ear tag number.

Registration is permitted at any age, but a penalty fee system and parentage tests persuade breeders to register the vast majority of their calves shortly after birth.

QUALIFIED ENTRY PROGRAM Of course, purebred Holstein cattle may be registered; in Canada, these trace back to black and white animals brought from the Netherlands during the latter part of the nineteenth century. However, a few animals enter through the Qualified Entry Program, which accepts females from the National Identification Program (NIP) under certain circumstances. The NIP system actually springs from the Joint Dairy Breeds Committee (JDBC) for all dairy cattle, although each breed association processes its own animals. The system is undergoing change at this time, and by 1990 each breed association will operate its own supplementary registration system and the NIP will terminate.

Figure 17 Holstein Canada's head office at Brantford, Ont.

JOINT DAIRY BREEDS COMMITTEE Breed associations share many registration rules through the JDBC. Well over 90% of the calves registered result from artificial insemination, and this committee publishes the rules governing them. Embryo transfer is treated similarly.

To let businesses offering AI or ET services maintain records that support the registration system, Holstein Canada cooperates with the other dairy breed associations by offering accreditation to reliable, responsible firms. The primary requirement is proper documentation and record keeping. Accredited businesses are subject to audit by the association, and they lose their accreditation if they don't operate by the rules. Holstein Canada's registration department administers the accreditation program for JDBC.

Figure 18 Part of the Holstein Association's registration department

BLOOD TYPING Any modern registration system needs blood-type analyses to verify parentage. To ensure the accuracy of the Herd Book, the association tests parentage on every thousandth calf registered, nearly all ET calves, all ET donor dams, all bulls entering AI service, all calves born after an unusual gestation length, and all calves of doubtful parentage.

To provide the blood typing service, the association, together with some of the beef breed associations, created Bova-Can Limited Parentage Testing Incorporated. Bova-Can contracts with the Saskatchewan Research Council to provide parentage testing for all bovines in Canada and for research to improve the accuracy of its work. The council, which operates the lab, ensures its international acceptability by participating in antigen exchanges with the other leading blood labs in North America and Europe. Holstein Canada is the largest user of blood typing in Canada, requesting over 9000 blood tests each year.

PERFORMANCE RECORDS The association maintains all official performance records for registered Holstein cattle in Canada. The computer file contains only about one decade of information, however, since this generally satisfies day-to-day needs. Earlier data is stored on microfiche. While milk records make up the largest part of the file, it also contains type classification reports, major show winnings, important awards and other information. The amalgamation of the NIP system and the registration system will substantially increase the already large database.

This database lets the association provide a wide range of computerized information services to breeders, exporters and other organizations in the industry:

- Customized and comprehensive official sale catalogs for auction sales.
- Extended pedigrees containing a wide range of official information in the format required by the enquirer.
- Searches of all living Holsteins for animals that meet certain specifications for export, AI and ET selections, genetic evaluation and other purposes.
- Elite cow lists that rank cows according to the criteria the enquirer specifies.
- The publication *Who's Who in Canadian Holstein Sires*, containing the current complete proof information on all recently proven bulls in the Canadian Holstein population.
- The *Better Breeding Directory* that ranks the top 100 proven sires currently active in Canada, according to milk, fat, protein and type rating.

OTHER SERVICES Some services are not quite so obvious to association members. The Genetic Improvement Department, aside from operating the type classification program, also works with a research committee that guides universities and governments on genetic research of value to breeders. Their findings, together with other observations, help the Breed Improvement Committee recommend a course of action for the entire breed. Each year, many meetings are held, articles written and studies undertaken in this field.

The Member Relations and Promotion departments provide liaison between head office and the field services. In addition, the Promotion Department writes a special section for the *Holstein Journal* to convey association news to members. This department also produces promotional literature of various kinds for use both inside Canada and abroad.

A roster of official judges, selected each year at conferences across the country, ensures consistency and reliability at Holstein shows. At major shows, special controls eliminate any possibility of unethical animal preparation or showing. Special classes for showmanship train breeders in the presentation of their animals in the show ring. The Promotion Department also publishes manuals on this activity.

Holstein Canada frequently helps foreign Holstein associations create new programs for their members. While it cannot provide such assistance free, it often finds funds from other sources for this important activity.

Artificial Insemination Units

Canadian AI units play a major role in the Holstein breed. Over 90% of all purebred Holsteins and over 80% of the NIP-identified grade Holsteins result from artificial insemination.

Technicians employed by an AI center perform approximately 800 000 first services, using semen from bulls owned by the same center. Over one-third of a million doses are sold by AI units to other Canadian units, much of it as a result of a deliberate policy of sharing and exchange. An increasing number of farmers perform the artificial services themselves from their own storage tanks.

The AI organizations in Canada are predominately farmer-owned cooperatives. They are highly oriented toward genetic improvement of their members' herds. They vary considerably in size; Quebec, the largest milk-producing province, is served by the single largest unit. Ontario, next in milk production, is served by three major units and one small unit. In addition, there are semen-producing AI units in British Columbia, Alberta, Saskatchewan, New Brunswick and Nova Scotia.

COOPERATION AMONG AI UNITS Because most AI units are cooperatives, they have had a natural inclination to cooperate with one another. The joint purchase of bulls and sharing of semen has recenty expanded, for example, to stabilize the finances of the smaller units and to assure all breeders ready access to top-quality bulls. Joint committees consider health and regulations, genetic selection, semen processing techniques and other subjects of common interest. All are members of the Canadian Association of Animal Breeders (CAAB), contributing to its research programs and other activities. Through CAAB, they also cooperate closely with Holstein Canada and other breed societies.

SIRE SELECTION PROGRAM In the Holstein breed, the sire selection criteria and system are based upon Holstein Canada's breed improvement strategy. The strategy was a product of the cooperation between the AI units and the association, and is subject to periodic review and modification.

The number of young sires entered into the progeny testing program at the AI centers has increased from 175 in 1981 to 286 in 1986, as shown in Table 6.

Although bulls are selected on a large number of criteria, pedigree indexes reveal the emphasis placed on the key characteristics. Table 7 clearly shows the trend.

Table 6 Number of Young Sires Entered on Test at the AI Center, 1986

New Brunswick and Nova Scotia Cooperatives, jointly	13
Centre d'insemination artificielle du Québec Inc.	117
Eastern Breeders Inc. (Ont.)	42
United Breeders Inc. (Ont.)	46
Western Ontario Breeders Inc. (Ont.)	30
Western Breeders Service (Alberta)	12
British Columbia Artificial Insemination Center	21
Universal Genetics (Alberta) and St. Jacobs Artificial Breeding Cooperative (Ont.), jointly	5
Total	286

Source: CAAB

Table 7 Holstein Pedigree Indexes Based on 1986 Base Values

YEAR	NUMBER OF BULLS	MILK YIELD	FAT YIELD	PROTEIN YIELD	FINAL CLASS
1980	144	−2.13	−1.95	−1.47	1.67
1981	182	−1.03	−0.78	−0.76	2.14
1982	216	0.50	0.77	0.17	2.82
1983	248	1.96	2.19	1.54	3.19
1984	217	2.33	2.81	1.86	3.01
1985	279	3.47	4.02	3.00	2.98
1986	277	3.91	4.82	3.25	4.12

Source: CAAB

AI EXPORTS In 1987, Canada sold 1.5 million units of Holstein semen to 50 countries, mostly through Semex Canada Ltd. In part, export sales help Canadian AI units moderate their cost of service to members. They let the units place greater emphasis on genetic selection and the range of blood lines offered to both members and offshore buyers. In addition, they support investment in research, improvements in semen-processing technology and education of breeders in genetic evaluation.

DISEASE CONTROL Because most are cooperatives, AI units still permit visitors in most of their barns. However, federal veterinarians screen all bulls entering a unit for tuberculosis, brucellosis, leptospirosis, paratuberculosis, bluetongue, epizootic hemorrhagic disease of deer, enzootic bovine leucosis, and campylobacter and trichomonas infections. These tests are repeated routinely on all resident AI center animals at annual or semi-annual intervals. Federal veterinarians also test bulls on demand according to the requirements of any country for which exports are being prepared. As a result, Canadian semen enjoys access to virtually every country where Holstein cattle are bred.

Figure 19 Visitors to an AI unit looking at semen under a microscope

Embryo Transfer Businesses

In Canada, embryo transfer (ET) is a big business in a small way. The Joint Dairy Breeds Committee accredits 109 embryo transfer firms. Holstein Canada registered 5272 ET calves in 1987. As the statistics reveal, most businesses are small, usually veterinary clinics that offer this and many other services to their regular clients.

Canadian breeders use embryo transfer in several ways.

A cow considered eligible to be the dam of a bull in AI in Canada or abroad is usually subjected to this process. The cows most in demand frequently have over 50 offspring by embryo transfer.

Cows that are superior but are not likely to be bull dams may produce more progeny through single-egg flushes. In this way they can continue to produce milk, avoid drug reactions and still double the number of offspring in the herd or for sale.

Nearly all eggs are removed nonsurgically. Nonsurgical implantation, however, is not quite so popular, particularly where the donor dam is extremely valuable and the recipient not. Frozen embryos are gaining popularity because they avoid the problem of accurate heat synchronization. Since a freezing technique has not yet become standardized worldwide, it is not uncommon for the same team of experts to freeze and thaw the embryos, even if these activities are widely separated in time and location. This is particularly true for exports of highly valuable embryos.

EMBRYO TRADE IN CANADA Before embryo transfer became common, AI units regularly contracted for prospective breedings to obtain many of their young bulls. Now that breeders commonly practice ET on their best cows, units find it possible to purchase more bulls after birth. A wide selection of pedigrees is available. Elite auction sales include numerous ET animals with outstanding pedigrees. It is not surprising that embryos themselves are not traded widely in Canada.

Holstein Canada publishes an embryo trading newsletter in which breeders can advertise embryos from their best cows. Most sales (often of fresh embryos) occur between neighbors. Many embryos are sold while in their recipient dam, at auction or by private treaty. In general, however, buyers still prefer to see a live animal that is well developed and consistent with its pedigree. Breeders generally find that they can obtain the best return by selling live ET offspring, rather than embryos, in the domestic market.

NEW ROLES FOR EMBRYO TRANSFER An exciting application for embryo transfer is disease prevention. Agriculture Canada's Animal Diseases Research Institute in Ottawa is a world leader in embryo washing, a technique that promises to permit shipping disease-free embryos internationally, even from diseased donor dams. It is already common to use embryo transfer to eliminate leucosis from a prominent cow family within a herd.

Several Canadian ET businesses perform embryo splitting commercially. Calves registered from split embryos carry the word "SPLIT" next to their name on their registration certificate. Transnuclear cloning has been successful on a trial basis, but is not yet commercially available.

Figure 20 A Holstein cow with her ET calves

These techniques of manipulating embryos mark but the beginning of a whole new area of exciting research. Several Canadian universities and government research institutes now study the use of DNA probes and DNA mapping to eliminate or prevent disease, to block the inheritance of defects, to gain an understanding of genetic transmission and to serve other purposes. In addition, embryo transfer has given us an opportunity to modify breeding strategies and to accelerate genetic gain, when used in combination with artificial insemination. A variety of such strategies (e.g., MOET-Multiple Ovulation and Embryo Transfer) have been implemented in Canada recently.

EMBRYO EXPORT Canadian Holsteins enjoy such good health that buyers in most countries can purchase live animals. When all costs are considered, live animals are less expensive than embryos; moreover, buyers can see the animals they are getting.

However, the export sales that have occurred have been highly successful, particularly in recent years; about 60% of frozen embryos exported result in pregnancies. As a result, Canadian exporters are able to sell embryos as pregnancies. In buying an embryo, one has access to both sides of the pedigree, an advantage to a buyer. However, until sex can be predetermined, embryo exports are not expected to be a large factor in trade except where health restrictions and/or distance make movement of live animals extremely expensive or impossible. In 1987, Canada exported 1307 dairy bovine embryos to 12 countries.

Foreign breeders can buy embryos through several Canadian companies. All members of the Canadian Livestock Exporters Association, Semex Canada Ltd. and several embryo transfer businesses actively pursue export sales. They contract with the owners of suitable donor cows to have the eggs frozen. They can arrange for teams of Canadian specialists to implant the embryos in the country of destination. A variety of contractual arrangements is possible, depending upon the needs of the customer. Although Canadian breeders prefer to have their cows flushed on the farm, quarantine facilities are available when health regulations necessitate extensive checking of an animal.

Figure 21 Students learn the techniques of embryo transfer.

National Coordination

The Canadian dairy cattle breeding industry places great value on animal improvement programs. It coordinates data collection and analysis of production programs at a national level. Voluntary concensus between all industry participants determines policy and long-term strategy.

GENETIC IMPROVEMENT

The National Advisory Council for Dairy Animal Improvement advises federal and provincial departments of agriculture and other industry organizations on genetic improvement. Agriculture Canada plays a pivotal role in coordinating the efforts of all member organizations.

The council is made up of representatives from:

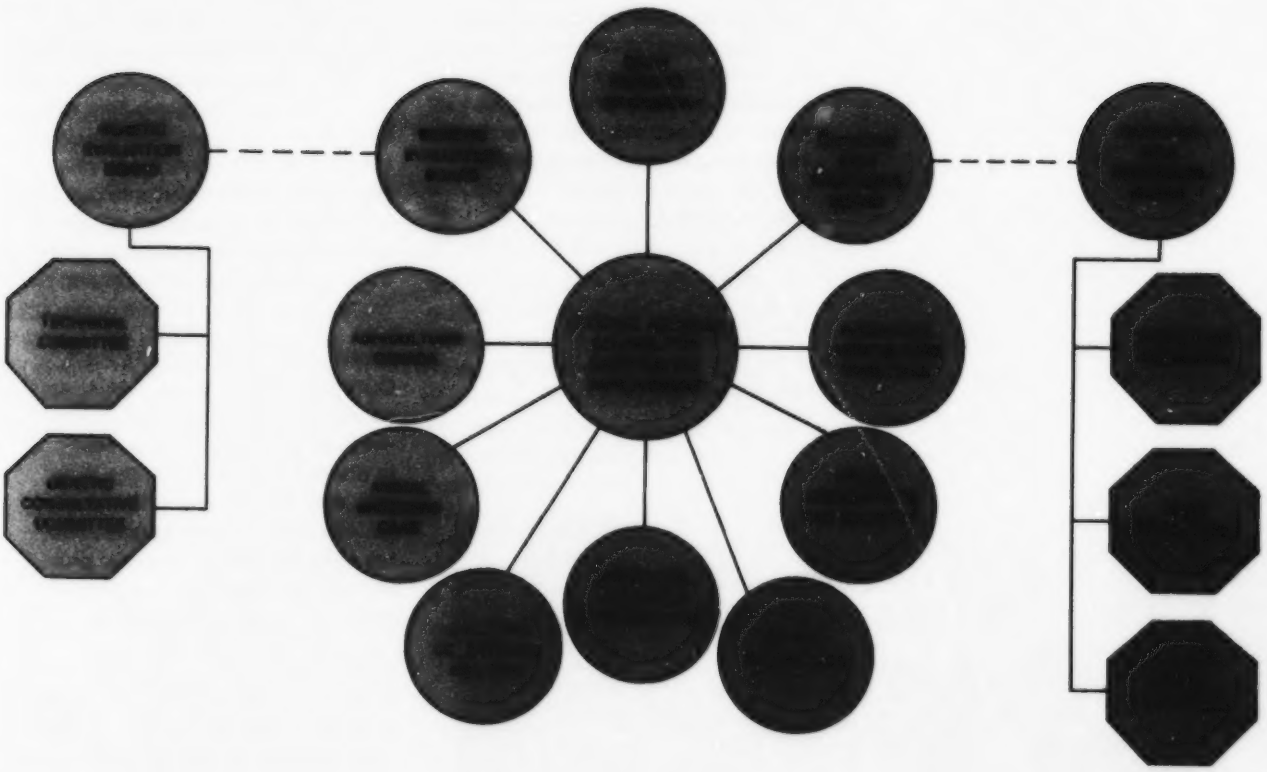
- the Genetic Evaluation Board;
- the Canadian Milk Recording Board;
- the federal government (Agriculture Canada) and provincial governments;
- federal (Dairy Farmers of Canada) and provincial milk-marketing agencies;
- artificial insemination centers (Association of Animal Breeders);
- breed associations or societies; and
- standing committees, e.g., the Canadian Dairy Information Exchange Committee (CDIE).

Through this regular contact with one another and the organizations they represent, the members encourage and develop programs that produce superior animals. They foster cooperation and coordination between industry and government and identify needed research and consultation.

The Genetic Evaluation Board is made up of two committees — one of five researchers appointed by Agriculture Canada and one of five members of the dairy industry, representing the Joint Dairy Breeds, the Canadian Association of Animal Breeders and the Milk Recording Board. The board:

- evaluates and recommends genetic evaluation methodology, breed improvement programs, data-collection techniques that increase evaluation accuracy, and the use of data in individual herds;
- recommends inclusion in the collection programs of traits that will enhance herd and genetic improvement;
- helps obtain data analysis research funds and recommends their allocation; and
- studies matters referred by the advisory council.

Figure 22 Canada's National Advisory Council for Dairy Animal Improvement



The Canadian Milk Recording Board, through its standards and audit committees:

- establishes procedures, standards and guidelines for official and unofficial milk recording, i.e., brings together the standards for all the provinces, reviews standards of other countries, and evaluates measuring and sampling devices;
- monitors or audits the milk recording agencies to ensure they comply with the standards in their labs, data processing services and in the field;
- certifies the agencies and authorizes them to issue the board's production certificates; and
- is the main source of Canadian milk recording statistics.

The board is made up of representatives from each milk recording agency. It also encourages participation in milk recording and annually produces statistics for milk recording in Canada.

The Canadian Dairy Information Exchange Committee (CDIE), a new player on the Canadian scene, arose in 1986 from a need for standardized and compatible electronic data within the industry. A memorandum of understanding among the milk recording organizations, the breed associations, the AI industry, research institutions and others facilitates bilateral contracts that permit an efficient and fair exchange of data.

DAIRY SIRE COMMITTEEMEN'S CONFERENCES Every 3 or 4 years, all personnel involved in selecting sires for Canadian AI units meet to discuss their work and the tools available. Subjects include improved genetic evaluation techniques, new breeding strategies, particular problems in the breed and common problems. Jointly hosted by the Canadian Association of Animal Breeders and Holstein Canada, the conferences have contributed greatly to Holstein Canada's breed improvement strategy. Benchmark 100, a special international edition of this conference, was held in 1984, Holstein Canada's centennial year. Visitors from all over the world were greatly impressed with the caliber of discussion and the open attitude of the Canadian industry to valid criticism from any source.

Figure 23 Speakers at Benchmark 100, an international conference held in 1984

RESEARCH

Most funding for dairy cattle research in Canada comes from government sources, but CAAB, SEMEX and Holstein Canada all help the universities and governments determine priorities. Dairy Farmers of Canada is also active in areas other than genetic improvement. The consultative mechanisms in research are not as clearly defined as they are in genetic improvement.

Comprised of university and government representatives, the Canadian Agricultural Services Consultative Committee (CASCC) coordinates much of the funding given agricultural research in Canada. Although not directly represented, industry makes its voice heard second-hand, through consultation.

The CAAB, SEMEX Canada Ltd., and Holstein Canada all contribute to research in genetic improvement and related fields. No formal structure links their policies, but reciprocal cross-appointments and frequent staff consultations ensure that the three organizations complement one another in their funding strategies and priorities. From time to time, they hold special conferences and symposia to raise general awareness of research issues and to obtain support for changes in approach.

OPERATIONS

Breeders cannot obtain progeny proofs of bulls without adequate milk recording facilities, type classification, and other programs offered by a variety of organizations. Similarly, because cooperatives or governments operate most of the organizations, they seldom compete in offering services to breeders. Holstein Canada seeks every avenue to reduce the cost and increase the efficiency of services to breeders by rationalizing and coordinating these.

The AI units offer a subsidy to herd owners who use their young sire program, and who also participate in official milk recording and type classification. The AI industry normally bases its breeding advice services on Holstein Canada's type classification program and official milk records, rather than on some independent scale or evaluation system. Joint promotion of data collection and genetic evaluation systems is common. Special incentive programs to promote participation link the different organizations from time to time.

Data networks have not yet become integrated. The CDIE will, in due course, make integrated data services available to farmers. It foresees a much more complete herd analysis and advisory service.

A new herd-records system has just been created through a collaborative study by Holstein Canada, the AI industry and milk recording representatives. It promises to greatly reduce the cost and inconvenience of record keeping for herd owners, while minimizing errors and complications for the organizations receiving the information. The system should lead to compatability of herd records on many farms.

The National Animal Health Program

Agriculture Canada has a comprehensive national animal health program to maintain Canada's high health standards and provide disease-free animals.

The Food Production and Inspection Branch is responsible for program planning, management of laboratories and coordination. Two major facilities and six others offer diagnostic services and conduct animal disease research. An operational directorate with seven regional directors across the country delivers the program. Each region is divided into districts, with a district veterinarian in charge of animal health activities.

The national program employs approximately 940 persons, including 307 veterinarians and 37 research scientists. There are 135 field offices, three quarantine stations for offshore imports of livestock and four quarantine stations on the Canada-U.S. border.

DISEASE CONTROL

At approximately 85 airports, seaports and landports, customs officers and field inspectors monitor livestock and animal products for signs of foreign animal disease, while health program personnel study the evolution of outbreaks in other countries. Canada is free of serious livestock diseases such as rinderpest and foot and mouth disease. Rinderpest has never been reported in the country and foot and mouth disease was eradicated after a brief outbreak in 1952. A nationwide emergency network of department employees responds to any disease that does slip into Canada. Agriculture Canada trains veterinarians in the diagnosis and control of such diseases. In addition, Canada, the United States and Mexico comprise the North American Foot and Mouth Disease Vaccine Bank.

Brucellosis was eradicated officially from Canada's domestic cattle population in 1985. In accordance with international practice, we will continue peak surveillance of animals at abattoirs and livestock markets into the 1990s and will continue to test milk.

Tuberculosis has been very nearly eliminated. Canada aims to be officially free of it by 1989. When lesions are found in an animal at slaughter, Agriculture Canada traces the herd of origin, destroys it and compensates the owner.

Canada is free of bluetongue, except in the Okanagan Valley of southern British Columbia where an occasional incursion from the United States appears. The narrow valley is bounded by mountains east and west, but is open south to the United States. To ensure that infection remains confined to the valley, Agriculture Canada conducts regular intensive serosurveillance and movement control.

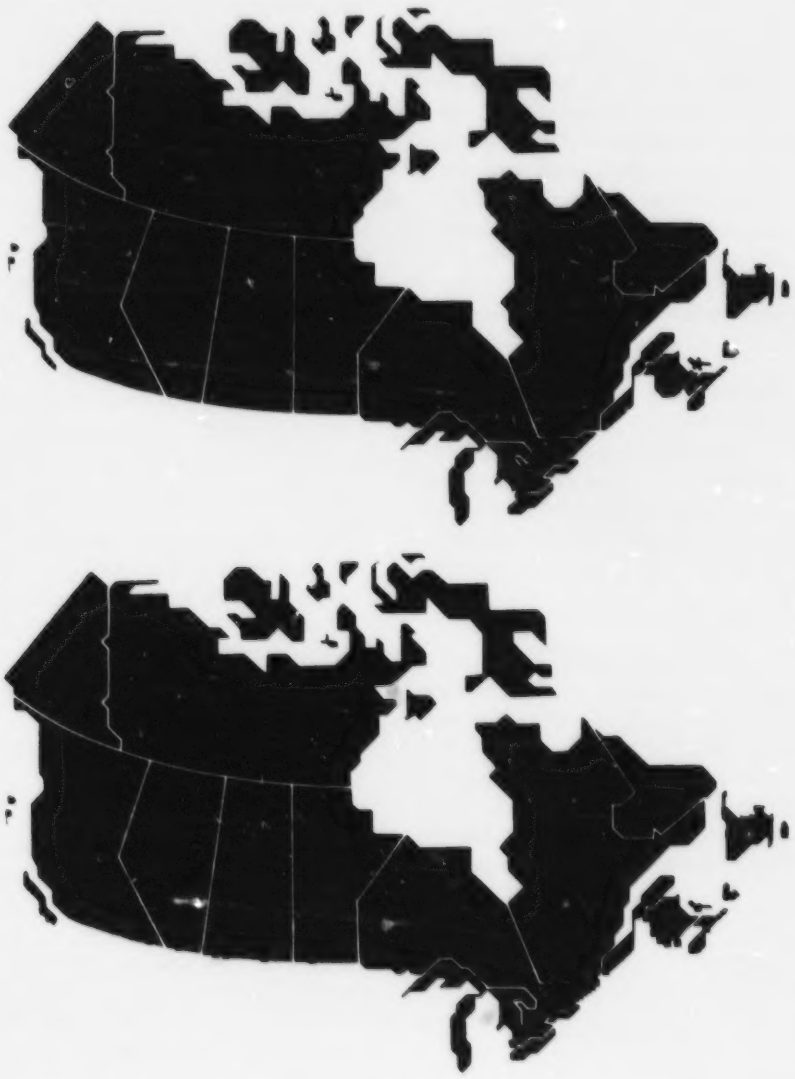
Figure 24 The locations of Canada's veterinary colleges, laboratories and inspection ports

VETERINARY COLLEGES ○

DIAGNOSTIC (FEDERAL, PROVINCIAL LABORATORIES) *

ANIMAL PATHOLOGY LABORATORIES ◆

INSPECTION PORTS ▪



DISEASE RESEARCH

Agriculture Canada's research tries to gain an understanding of animal disease in its broadest sense, so that control methods can be developed. Part of the work has been devoted to devising new diagnostic techniques such as ELISA (enzyme-linked immunosorbent assay) and the even newer molecular biological methods such as DNA probes. The techniques can then be adapted for routine use.

The department's research achievements have already led to benefits and promise greater ones in the future. The brucellosis program has helped eradicate this disease from Canada, while those on foreign animal diseases help us prevent diseases such as foot and mouth, hog cholera and pseudorabies from gaining a foothold. Paratuberculosis, respiratory diseases of cattle and sheep, perinatal mortality and scrapie are important subjects for research that should yield results that can be applied on the farm. The department is investigating freedom from infection through semen and embryo transfer.

INTERNATIONAL ACTIVITIES

Officers of the National Animal Health Program have numerous international contacts with whom they exchange animal disease information on incidence, diagnosis and research. They and their contacts also negotiate zoosanitary certificate conditions for the import and export of breeding animals, semen, embryos, meat and other animal products.

Agriculture Canada maintains memoranda of understanding and official arrangements with a number of countries to ensure formal and regular exchanges and cooperation in animal health and disease research.

Staff of the program participate in development projects overseas through cooperation with the Canadian International Development Agency and other international groups.

Canada participates actively in multilateral animal health programs through agencies such as the International Office of Epizootics, the Inter-American Institute for Cooperation on Agriculture, the Pan-American Health Organization and the Food and Agriculture Organization of the United Nations.

Figure 25 An Agriculture Canada animal pathology laboratory

EXPORT CERTIFICATION

Agriculture Canada designs programs to regulate exports and negotiates with other countries on their health requirements for Canadian livestock. In 1986, for example, Canada exported its first bovine embryos to The People's Republic of China and the USSR, with the department implementing the export certification database.

To ensure the health of exported animals, the Animal Disease and Protection Act and Regulations stipulate that all livestock exported from Canada have a health certificate. This must either be completed by a veterinary official of Agriculture Canada or endorsed by one when an accredited veterinarian's services have been employed (to practice in Canada, veterinarians must be licensed by their provincial veterinary associations).

The Food Production and Inspection Branch's laboratories carry out the tests that form the basis for certification. Canada's certification system ensures compliance with the importing country's animal health requirements. The labs verify the health of animals being imported and of breeding animals in artificial insemination and embryo transfer centers. Animal Health Program staff frequently accompany export shipments of breeding stock.

Figure 26 An Agriculture Canada veterinarian taking a blood sample from a bull

Export Facilities

Offshore buyers seek Canadian Holsteins for several reasons: yield, longevity, superior milk composition, strength and dairyness. Because of their size and rate of gain, Holsteins also suit dual-purpose applications as either meat or draft; in these situations they are often used in crossbreeding programs.

The figures in Table 8 reflect recent subsidization of exports by the U.S. government. Moreover, state regulations in the U.S. require that all animals entering be vaccinated for brucellosis. Since Canada is free of brucellosis, vaccination is not widely practised here, making Canadian cattle ineligible for sale to many American states.

CANADIAN LIVESTOCK EXPORTERS' ASSOCIATION (CLEA)

CLEA, made up of 15 livestock export firms across Canada, is the only recognized association of its kind in the country. Holstein Canada, not a buyer or seller of livestock itself, endorses CLEA members as the most reliable exporters of Holstein cattle and cooperates exclusively with them.

Members individually coordinate shipment details from the Canadian farm to the foreign port. They arrange export financing and the appropriate health testing, provide needed documentation and treat animals as necessary before shipment (modern facilities, approved by official Canadian health authorities, allow proper pre-embarkation care of the cattle). They also charter the aircraft or vessels. Most animals are shipped by air freight; large orders may go by sea. In both cases, great care is taken to ensure their safe arrival and losses are minimal. The few losses that do occur are recorded.

The hallmark of the association is reliability and integrity. To ensure optimum service to buyers and sellers and maintain high standards among its members, CLEA rigorously applies its Standard Sales Practices and a Code of Sales Ethics. Although membership is open to all Canadian livestock exporters, applicants are screened for reliability, experience and financial integrity. Any member firm that brings disrepute to the organization is ejected and a penalty bond is seized.

Figure 27 Holstein heifers prepared for shipment by air

Table 8 Registered Canadian Holstein Cattle Transferred for Export

COUNTRY	1987	1986	1985	1984	1983	TOTAL
Algeria	104					104
Argentina	50	4	3	3	4	64
Australia	19		2	3		24
Austria		12	109			121
Barbados	72					72
Brazil	219	21			-4	236
Bulgaria			70	6	89	165
China		63	104			167
Colombia	27			170	725	922
Czechoslovakia			25		22	47
Denmark	3					3
Ecuador	14	188	269	14		485
France	136	156	97	150	158	697
Hungary	3		11			14
Iran				496	1 340	1 836
Ireland	10			5		15
Italy	17	11	8	235	295	566
Japan	20	118	66	49	18	271
Korea		4	490	7 784	3 564	11 842
Mexico	38	122	1 722	542	11	2 435
Morocco					741	741
Netherlands	15	4	10	19	83	131
New Zealand	4	2	3	1		10
Nicaragua		445	1 947	454		2 846
Peru	674		75	147		896
Puerto Rico	1					1
Saudi Arabia	1	642	506	333	71	1 553
South Africa	1		1			2
Spain	1 179	2 048	7		207	3 441
Sweden			20		36	56
Taiwan	187	92				279
Tunisia	101					101
Trinidad		13	2			15
USSR	252	16	167		133	568
United Kingdom	81	72	99	285	269	806
Uruguay	5					5
Venezuela	53	3 297	302	355	262	4 269
West Germany	5	11	1	12	18	47
TOTAL OF ABOVE	3 291	7 341	6 116	11 063	8 042	35 853
TOTAL TO U.S.	5 346	6 548	6 670	5 721	9 714	33 999
GRAND TOTAL	8 637	13 889	12 786	16 784	17 756	69 852

Source: Holstein Canada

Previously, Canada has exported registered Holsteins to: Bahamas, Belgium, Bermuda, Bolivia, British Guiana, Chile, Costa Rica, Cuba, Curacao, Dominican Republic, East Germany, Eire, El Salvador, Ghana, Greece, Guatemala, Guyana, Haiti, Honduras, India, Iraq, Jamaica, Kenya, Luxembourg, Malawi, Martinique, Mozambique, Palestine, Poland, Portugal, Romania, Swaziland, Switzerland, Tunisia, Turkey, Uganda, Uruguay, Yugoslavia and Zimbabwe.

Members compete with one another on the export market but, as an association, act to benefit one another, the industry and the buyers. On large orders they supply one another as subcontractors. Together, they represent the livestock export industry in discussions with government and related organizations. Their experience lets them advise Canadian and foreign governments of the suitability of particular health regulations and other terms of sale. From time to time, members also collaborate on market development through participation in trade missions and fairs.

SEMEX CANADA

In 1987, Semex Canada Ltd. took over the export business of the Ontario Association of Animal Breeders, which had used the name Semex since 1974. Owned by the three major dairy AI units in Ontario, the earlier association had acted as an agent for the other dairy AI units as well. With the change in structure, all of the AI cooperatives became owners of Semex Canada Ltd.

Like its owners, Semex Canada does not operate for profit. It provides a service to its owners, for the benefit of the industry. Any surpluses it earns are used for the expansion of the business, research or for the general good of the industry.

Semex does not operate in the United States; Universal Genetics and Elmira-St. Jacobs ABC, jointly, export directly. With these exceptions, Semex Canada Ltd. is the exclusive marketing agency for Canadian Holstein semen. It works closely in many countries with members of the Canadian Livestock Exporters Association. Strong competition exists in the new embryo trade, but the success of Canadian Holstein semen has helped Semex continuously expand its business. Not only does Semex employ sales directors for each major area in the world, it also has a sophisticated computer department to analyze genetic data, create programs for use on major farms abroad, and, of course, to run its own business. It employs a specialist in reproductive technology to advise not only its owners, but also AI personnel in other countries.

Semex recently embarked on two new activities. It has undertaken artificial insemination projects in other countries (financed by international development agencies) and it operates the International Management Livestock Schools in Kemptville, Ontario. There, people from many countries train in all aspects of dairy farm management, artificial insemination, genetic evaluation and related subjects.

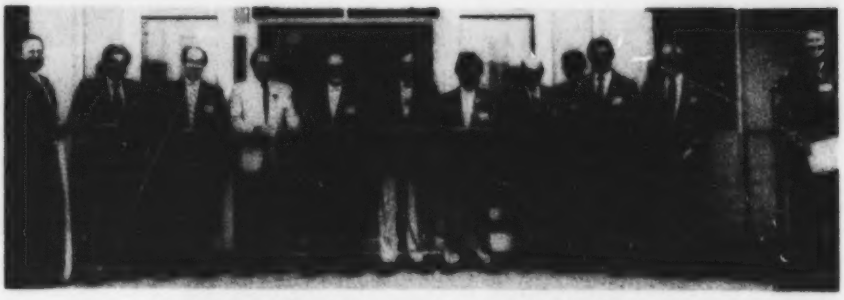


Figure 28 In 1987, Semex Canada opened its new head office.

Semex makes a major contribution to the dairy cattle breeding industry through its support of research. It has funded three research chairs at the University of Guelph — one in breeding strategies, one in reproductive physiology and the third in molecular biology — and contemplates further appointments. Semex also contributes indirectly through the Canadian Association of Animal Breeders. The Canadian AI units contribute to the CAAB research fund for every dose exported or used domestically. Largely because of the success of Semex, CAAB is able to support research not only in reproductive physiology and related disease, but also in genetic evaluation, heritable diseases and other important fields.

TECHNICAL SUPPORT

Like any high yielding animals, Holsteins produce best when properly fed and cared for. In many instances, foreign buyers need more than just basic information on feed and management; they need veterinary advice, soil and forage analysis laboratories, instruction and equipment for milking and artificial insemination, etc. Canada has created several avenues by which they can get this assistance.

CANADIAN INTERNATIONAL DEVELOPMENT AGENCY Based on percentage of gross national product, Canada is one of the largest donors of development assistance to the Third World. Because of the success of the Canadian dairy cattle industry, CIDA has been willing to grant a priority to dairy development projects in countries where they are needed.

BCAI CENTRE 1

WBS 2

EASTERN 3

WESTERN ONTARIO BREEDERS INC. 4

UNITED breeders inc. 5

SEMEX CANADA 6

CIAQ 7

New Brunswick Central Artificial Breeding Co-Operative Ltd. 8

Nova Scotia Animal Breeders' Co-op Ltd. 9

Figure 29 Locations of Semex Canada and its member units

Although not a part of the commercial trade, CIDA has provided complete dairy breeding farms with cattle, equipment, technical training and infrastructure support, as well as much less glamorous but essential aid.

CIDA supports training of personnel both abroad and in Canada, using a wide variety of instruction and training techniques. It has established AI centers, demonstration farms and educational institutes, schools, and courses. For countries eligible for its assistance, Canadian Holsteins can be combined with whatever technical support is necessary for their success.

INTERNATIONAL LIVESTOCK MANAGEMENT SCHOOLS This subsidiary of Semex Canada Ltd. was established in 1986 to provide practical training to buyers of Canadian semen and cattle through regular commercial channels. The schools use facilities leased from the Kemptville Agricultural College as their primary teaching location. Courses are not, however, confined to the classroom. Practical instruction in artificial insemination and embryo transfer are regular parts of the custom-designed courses. In addition, the schools arrange special training programs at other locations in Canada as needed, such as at universities, milk recording and data processing organizations, and Holstein Canada.

Normally, instruction is in English or French, but can be made available in any language. If a commercial transaction does not fully cover the costs of the courses, other sources of support can sometimes be found.

THE UNIVERSITIES Foreign students are a normal part of the scene at Canadian universities. The Centre for Genetic Improvement of Livestock at the University of Guelph trains students to utilize Canadian Holstein genetics more efficiently. Specializing in population genetics, the center has helped students from many countries establish national sire proving programs, milk recording systems, genetic evaluation programs, etc.

The University of McGill, MacDonald College campus, operates one of the best milk recording systems in Canada. In addition, it conducts research in a variety of areas, using the Province of Quebec's own large cow population as a source of data. For people wishing hands-on experience in a milk recording system and data processing center, MacDonald College is particularly suitable.

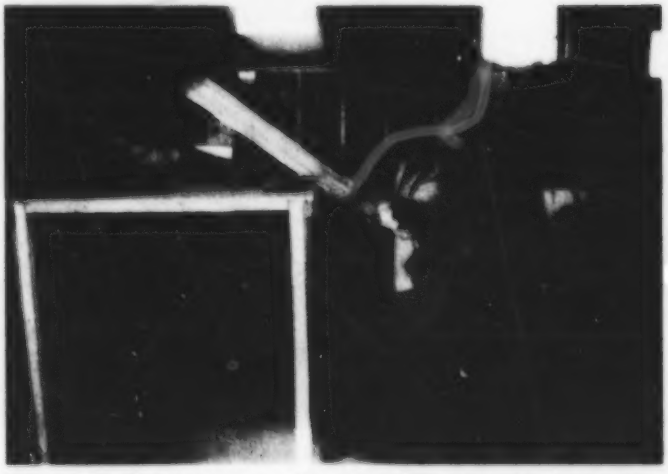


Figure 30 Building calf hutches at the International Livestock Management Schools

Figure 31 This Holstein heifer faces a new life in Korea.

OTHER TRAINING Holstein Canada offers training in a limited range of subjects. It organizes trainee programs, whereby young breeders or farm managers are brought to Canada for a year to obtain practical instruction in caring for dairy cattle on the farm. Aside from actually working on the farm, they receive source instruction in a variety of practical areas such as artificial insemination, milk recording, animal health, etc. Participants need a basic knowledge of English or French.

The association also helps Holstein associations in other countries improve their operations. It gives instruction in registration techniques, type classification, judging and the other activities of a breed association. Such assistance is also available through the ILM schools or as part of a CIDA contract.

The Canadian Livestock Exporters Association can provide practical technical assistance whenever it sells animals. On occasion, a purchaser will request a Canadian herdsman for the 6 months it takes the bred heifers to have their first calves. Sometimes a veterinarian will accompany the shipment and stay for weeks or months after arrival. If a purchaser needs more help, the exporter can arrange for staff over a longer term, courses at the ILMS or other kinds of assistance.

Figure 32 A Canadian veterinarian advising Peruvian breeders on embryo transfer

GOVERNMENT-TO-GOVERNMENT AGREEMENTS Although somewhat removed from the commercial trade, memoranda of understanding create very important mechanisms whereby Canada can help other countries use our Holstein genetics. Under such agreements, the Minister of Agriculture for Canada can offer a wide variety of technical advice, training sessions, educational programs, technical seminars and educational visits. Because of the variety and caliber of expertise available from Agriculture Canada, the memorandum of understanding has become a very important vehicle for carrying technical support to other countries.

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